

October 1992/\$3.00

Mobile Radio Technology

The journal of mobile communications technology



■ Digital technology, p. 10

■ Ultra-broadband portable

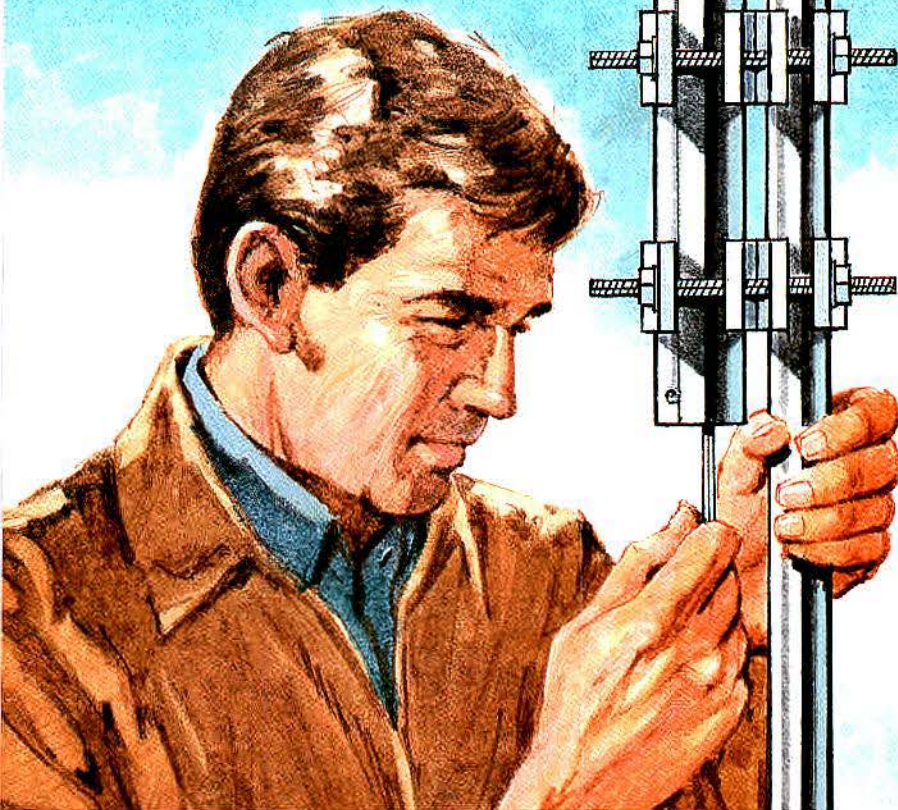
■ Logging recorders

■ Pressurizing RF feedlines

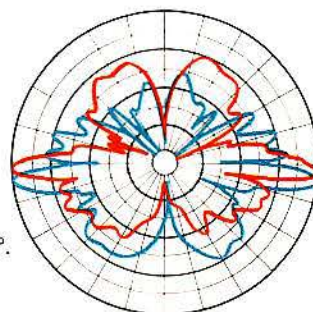
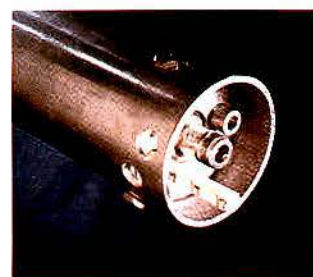
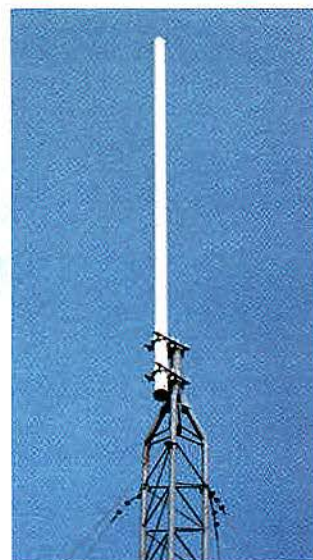
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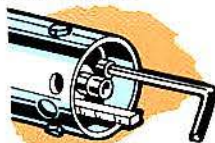
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■ -3° ■ -8°



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Circle (1) on Fast Fact Card

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Tim Twohig and Vicki Griesser

Linear predictive vocoding carries digitized voice on radio communications channels. How users migrate to digital technology has an important bearing on choosing among the three access methods.

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Richard L. Abrahams

Microprocessor applications solve ultra-broadband portable FM transceiver design problems. Dynamic calibration virtually flattens deviation vs. frequency.

34 Technology trends in logging recorders

Don Bishop

Analog recorders have plenty of market to serve, though the trend favors digital recording and solid-state storage media. How rapidly storage media prices drop may control how fast the use of digital recording grows.

50 Use pressurization to protect RF feedlines

Lloyd A. Keyser

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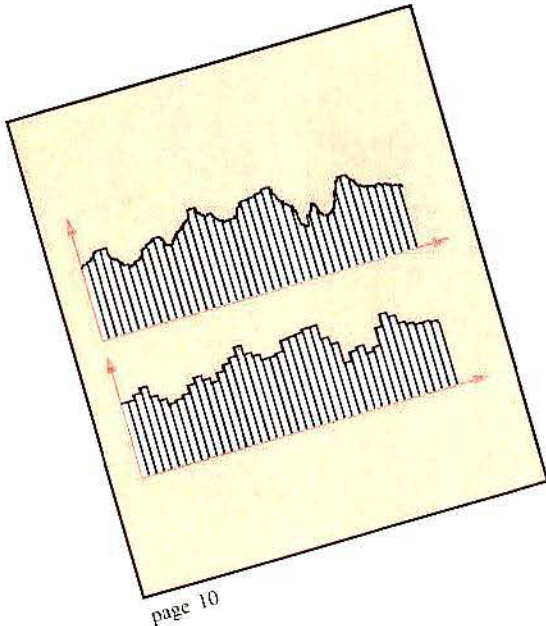
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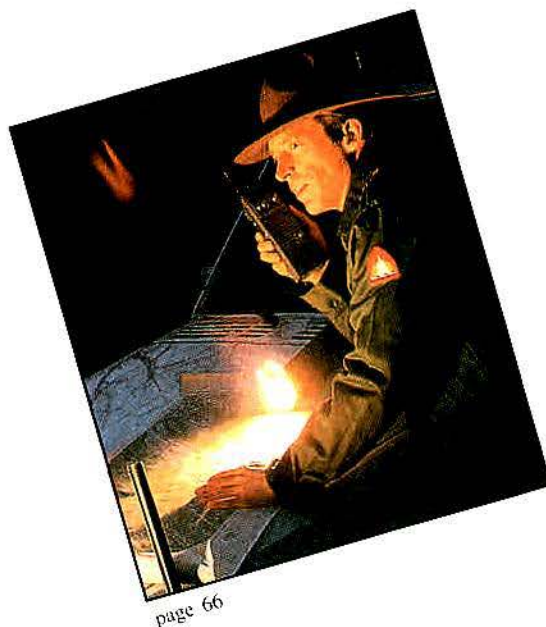
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RCC vs. private carrier paging.

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On the cover: Processing gives a digital look to a picture of portable two-way radio use. See Tim Twohig and Vicki Griesser's article on page 10.



The Eliminator

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Scanning . . .



UHF-TV sharing

Spectrum allocated for UHF-TV broadcasting has been shared by land mobile radio system operators in the largest U.S. cities for many years with great success.

FCC approval for additional sharing has been blocked by broadcasters who want spectrum for future advanced television (ATV) service, including high-definition television (HDTV).

Because ATV broadcasts may require additional frequencies, they would be broadcast on second 6MHz channels assigned to each TV station in the country. According to one plan, these second channels should be assigned only in the UHF band (not in the VHF band), a suggestion we endorse.

Each TV station's present transmitter would remain on the air to carry NTSC broadcasts. (NTSC is the name of the current U.S. broadcast TV technology, named after the National Television Standards Committee that formulated the video and audio broadcasting standard.)

The FCC would give each station five years to apply for a license and construct the new transmitter and another 15 years to broadcast simultaneous NTSC and ATV programs.

Here's the way we would like to see it done:

- The TV station must apply for an ATV license within two years or forfeit its ATV channel.

- A station with an ATV license must begin ATV broadcasting within three years of the license grant or forfeit the ATV channel.

- Only UHF channels will be assigned for ATV broadcasting.

- Within 15 years of beginning ATV broadcasting, the station must cease NTSC broadcasting and stay on the ATV channel or cease ATV broadcasting and stay on the NTSC channel.

Why do we want to see it done that way?

VHF spectrum that TV stations occupy would be freed for other uses (including land mobile radio, we hope) when broadcasters with successful ATV operations choose to shut down NTSC transmitters. The upper VHF channels (channels 7 to 13) are ideal frequencies for land mobile, and we advocate making some of these frequencies available to land mobile radio system operators.

VHF-TV broadcast operations have migrated to UHF in other countries, most notably in the United Kingdom. In the United States, ATV can offer the incentive, and FCC regulation can set the timetable for a similar migration.

Stations declining to initiate ATV service will relinquish their second UHF channel assignments, some of which then could be shared by land mobile radio users.

It is deplorable that spectrum requirements for radio communication go unfulfilled while the uncertain future of ATV broadcasting is deliberated. Implementing ATV service in a way that frees valuable VHF spectrum is a worthwhile course to follow in the meantime.

* * *

No telco SMRs

The FCC has terminated a rulemaking proceeding initiated years ago that proposed to allow wireline telephone companies to own specialized mobile radio (SMR) systems. Current rules do not allow such ownership.

The agency terminated the proceeding because the record was stale. There have been so many changes in the SMR and telephone industries that public comments submitted years ago are no longer useful, according to the commission.

Nevertheless, an FCC document reads that the commissioners believe prohibiting wireline telcos from owning

SMR systems continues to be useful.

The rule may be changed in the future if the SMR industry continues to consolidate and if the commissioners can satisfy themselves that permitting wireline entry will not harm competition.

Five wireline telcos currently own SMR systems thanks to FCC rule waivers. They acquired their systems as part of larger acquisitions of paging and cellular telephone businesses.

The waivers that were granted pending the outcome of the rulemaking proceeding expired when the proceeding was terminated, and the FCC ruling means the telcos will have to divest themselves of their SMR systems.

Or does it?

Actually, the telcos may re-apply for waivers and attempt to show that their continued ownership of the SMR systems is in the public interest.

Few people believe telcos want to own a small number of SMR systems, yet many believe telcos would be interested in buying multiple digital cellular SMR systems envisioned for the mid-'90s.

Whether they quietly divest themselves of the SMR systems they now own may not be a measure of the telcos' desires to enter the SMR industry in a big way. Those desires will be revealed if they petition for ownership privileges again.

—Don Bishop

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Circle (6) on Fast Fact Card

Tower lighting:

Although much of Patrick Feller's letter (See last month's column.) confirms information presented in my June article "Using White Lights To Mark Radio Towers," and a portion of it simply restates the Federal Aviation Administration (FAA) specifications, there are several points within his letter that require technical clarification.

These points could—and preferably should—be discussed in greater detail, but because space is limited in this column, a few paragraphs will have to suffice.

► *Fresnel vs. parabolic lenses*—Beam spread primarily is a direct function of the ratio of the source or plasma size and the optical element's focal length, i.e., a Fresnel lens or a cylindrical parabola, and is related by the equation:

$$Bs \propto K \tan^{-1} (Sg / Fl)$$

where

Bs = beam spread

K = empirical constant

Sg = source gradient

Fl = focal length

In comparing the EG&G FlashGuard 2000 to a Fresnel lens system, these ratios differ by approximately a factor of 2, and so do the measurements. Our most efficient Fresnel lens design maintains a beam spread of about 8° to 11°. The FlashGuard 2000 has a beam spread between 3° and 5° around a 360° horizon.

We could not improve the Fresnel lens beacon's performance by reducing the helical flashlamp source's size and/or increasing the Fresnel lens size to decrease the beam spread to less than

about 8° and still achieve the 20,000 candela required without excessive heating and reduced system life.

The unnecessary increase in beam spread simply is a waste of energy that is proportional to the integrated areas under the vertical beam profiles.

Figures 1 and 2 in the article are not exaggerated. They are substantiated and supported by measurement and visual observation.

Furthermore, the simple hypothetical exercise of comparing this type of Fresnel lens with its equivalent toroidal lens illustrates the cause and considerable extent of light scattering and transmission loss.

It is true, at any rate, that less than perfect atmospheric conditions can devastate a beam profile image's integrity.

► *Corona and ozone*—Corona produces ozone.

Today's flashlamps are fabricated from several types of doped quartz that

Mobile Radio Technology

The journal of mobile communications technology

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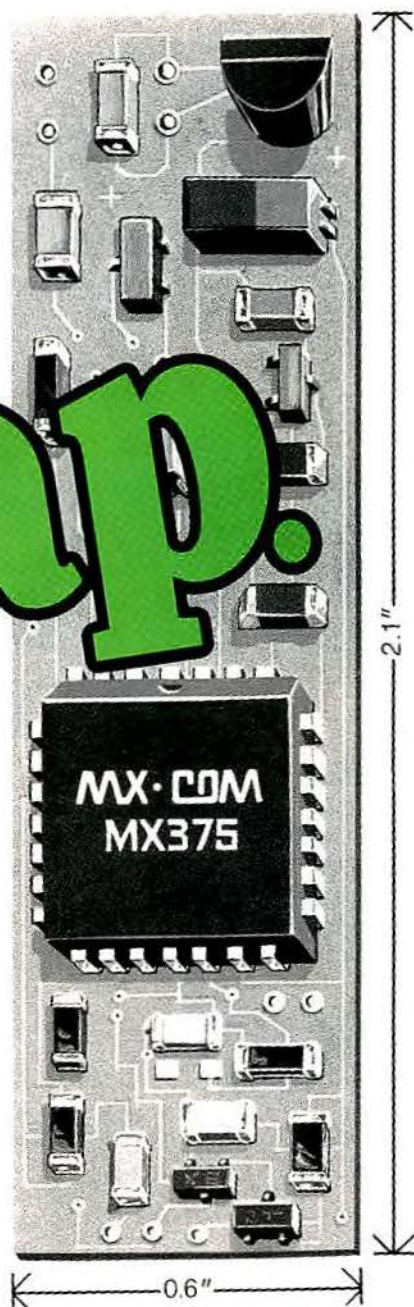
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Circle (7) on Fast Fact Card

Letters to the editor

do not transmit below 220nm, thereby eliminating ozone production from ultraviolet (UV) light output. EG&G flashlamps cut off at 330nm.

Nevertheless, external high voltage trigger wires used in other flashlamp systems *do* produce corona, resulting in ozone generation. Tests verify this statement.

Tests also verify that the FlashGuard

2000 produces less than 17 parts per billion of ozone, that number being the lower detection limit of the available test equipment.

► *Lens material and temperature*—Mr. Feller's letter did not indicate the internal lens temperature reached during operation (ambient plus rise), so it is unknown what the safety margin is on an acrylic with an 80°C (176°F) sta-

bility characteristic.

Tests have indicated that under certain conditions (100°F ambient), the operating temperature could reach or even exceed 175°F. The FAA specification is for operation in 55°C (131°F) ambient environments.

The UV-stabilized acrylics used in the FlashGuard 2000 have a continuous service temperature (CST) range of 118°C to 130°C (245°F to 265°F).

► *Flashlamp life*—The EG&G Flashguard 2000 beacon system was in development for two years prior to introduction.

EG&G is the only flashlamp designer and manufacturer among the strobe beacon suppliers, and the flashlamps used were designed and tested carefully for performance and reliability.

We are confident that the flashlamps perform well, as there are several hundred FlashGuard systems installed and operating in the field. We offer a two-year warranty to back this up.

Finally, the xenon flashlamp was developed in the 1930s by one of EG&G's founders. EG&G always has been a world leader in flashlamp design and manufacture for industrial, medical and scientific applications.

Lew Wetzel
Senior Sales Engineer
EG&G Electro-Optics
Salem, MA

Fast Fact Card comments:

The two toughest problems on the job are:

- (1) cold weather.
- (2) equipment on the shelf, waiting for parts that are on back order.

Larry Zuccaro
Energy Systems
Anchorage, AK

The toughest problems on the job include:

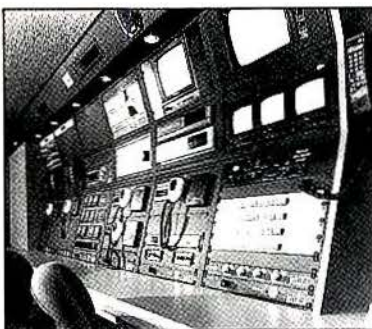
- meeting expanding needs with so little spectrum flexibility.
- keeping a maintainable fleet with so many changes in equipment.

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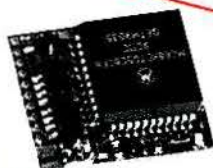
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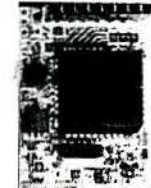
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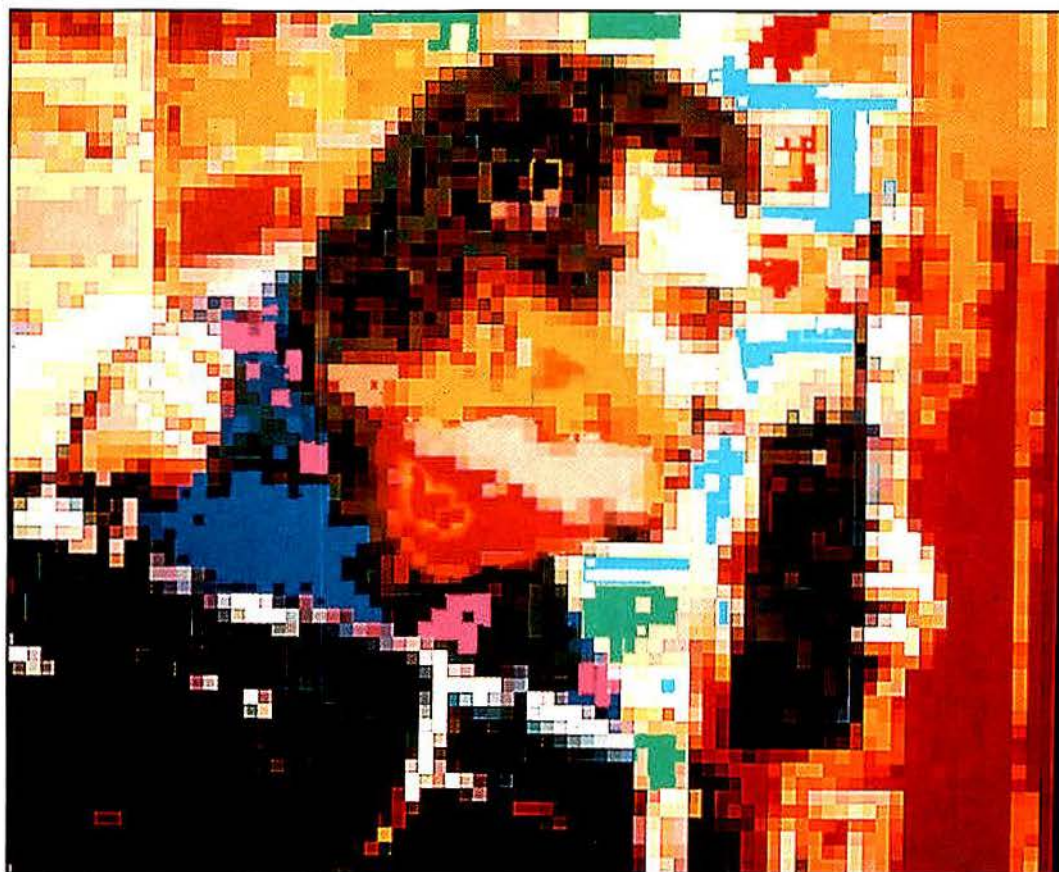
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Digital technology serves 2-way radio communications

Linear predictive vocoding digitizes voice on radio communications channels. How users migrate to digital technology has an important bearing on choosing among the three access methods.

By Tim Twohig
and Vicki Griesser

Digital voice modulation may relieve land mobile radio channel congestion, increase data transmission capacity and add advanced features.

Digital enhancements

► **Audio quality**—New linear predictive voice encoding (vocoding) techniques and forward error correction improve digital audio quality.

Semiconductor technology advances have produced digital signal processors (DSPs) that execute millions of instruc-

tions per second. Linear predictive coders use the DSPs' processing power to convert the analog voice signal to a digital signal using computational approximation. This processing type provides digital audio quality comparable to analog.

Digital systems can provide uniform audio quality throughout more of a system's coverage area. Near the transmitter, digital and analog audio quality are comparable. At the coverage area fringe, where analog audio quality suffers from noise and fading, digital audio with forward error correction can be much better. (See Figure 1 below left.)

As the radio signal weakens, noise and fading cause digital bitstream errors. The digital receiver compares inbound information with codes that correct bitstream errors to reconstruct the

transmitted audio (or data message) accurately.

► **Data capability**—Digital technology can increase a radio system's data capabilities in a number of ways.

On a digital system, voice and data are transmitted in digital form, making it easier to integrate them. Data and voice transmissions can be carried on a single channel without one interfering with the other.

Digital modulation schemes support higher data transmission rates than today's two-state frequency-shift keying (FSK) modulation. Some of the next-generation digital systems will use multistate modulation techniques such as quadrature phase-shift keying (QPSK) and quadrature amplitude modulation (QAM).

These modulation techniques allow

Twohig and Griesser are systems engineers at Motorola, Schaumburg, IL.

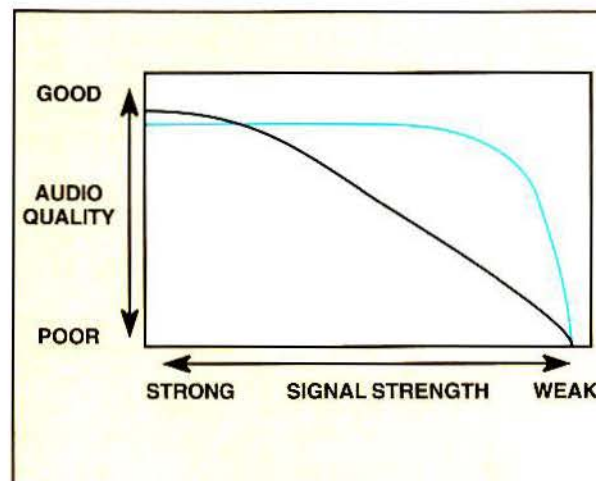


Figure 1. Digital audio quality surpasses analog quality as the radio signal weakens. At the fringe of the coverage area where analog audio quality suffers from noise and fading, digital audio with forward error correction can be much better.

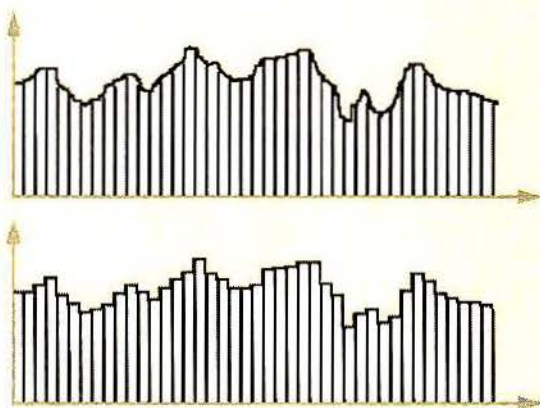


Figure 2. Pulse code modulation (PCM) samples the analog voice signal many times per second. Each sample is used to reconstruct the analog signal. At a rate that maintains high voice quality, PCM sampling generates more data than can be sent over a 25kHz-wide radio communications channel.

higher data rates by representing multiple bits with each state change. Using higher data rates makes applications that are too data-intensive for two-state modulation more practical. Some applications include data transmissions to and from laptop computers, peripherals and facsimile machines.

► **Spectrum efficiency**—Digital technology can carry more communications

on a given amount of radio spectrum, improving spectrum efficiency.

Voice modulation evolution

Long-distance telephone carriers were the first companies to digitize voice in the 1960s using 64kbps pulse code modulation (PCM).

PCM samples the analog voice signal level 8,000 times per second. Each

sample is represented by 8 bits of digital information that are used to reconstruct the analog signal. (See Figure 2 on page 11.) This coding method provides voice transmissions over long-haul wires with minimum noise and distortion.

When digital voice is sent over radio, the amount of data that can be sent over a given bandwidth is limited to provide acceptable performance to adjacent-channel users. With two-state digital modulation, it is impossible to transmit 64kbps digital signals over a 25kHz radio channel.

In the 1970s, vocoding techniques such as continuously variable slope delta (CVSD) modulation accurately represented a human voice using only 12kbps of information. This amount of data fits on a 25kHz channel with two-state digital modulation.

Unlike PCM, which samples the analog signal's level, CVSD samples its slope. The digital signal, made of binary (ones and zeros) codes, approximates the rising slope values with ones and falling slope values with zeros. (See Figure 3 below.)

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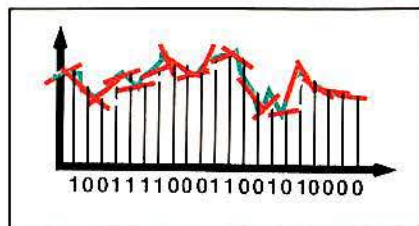


Figure 3. Continuously variable slope delta (CVSD) modulation samples the analog signal's slope. The digital signal, composed of binary (ones and zeros) codes, approximates the rising slope values with ones and falling slope values with zeros.

One bit of information represents each sample. Because CVSD vocoders degrade audio quality slightly, they are used only in encryption systems.

PCM and CVSD convert analog voice to digital voice by approximating the analog signal. Linear predictive vocoding uses the DSP's computing power to digitize voice by approximating the voice process.

The physical process of producing speech can be viewed as the mouth, nasal cavities and tongue acting to shape air impulses produced by the vocal cords (pitch is the frequency of these im-

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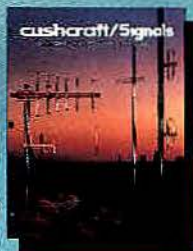
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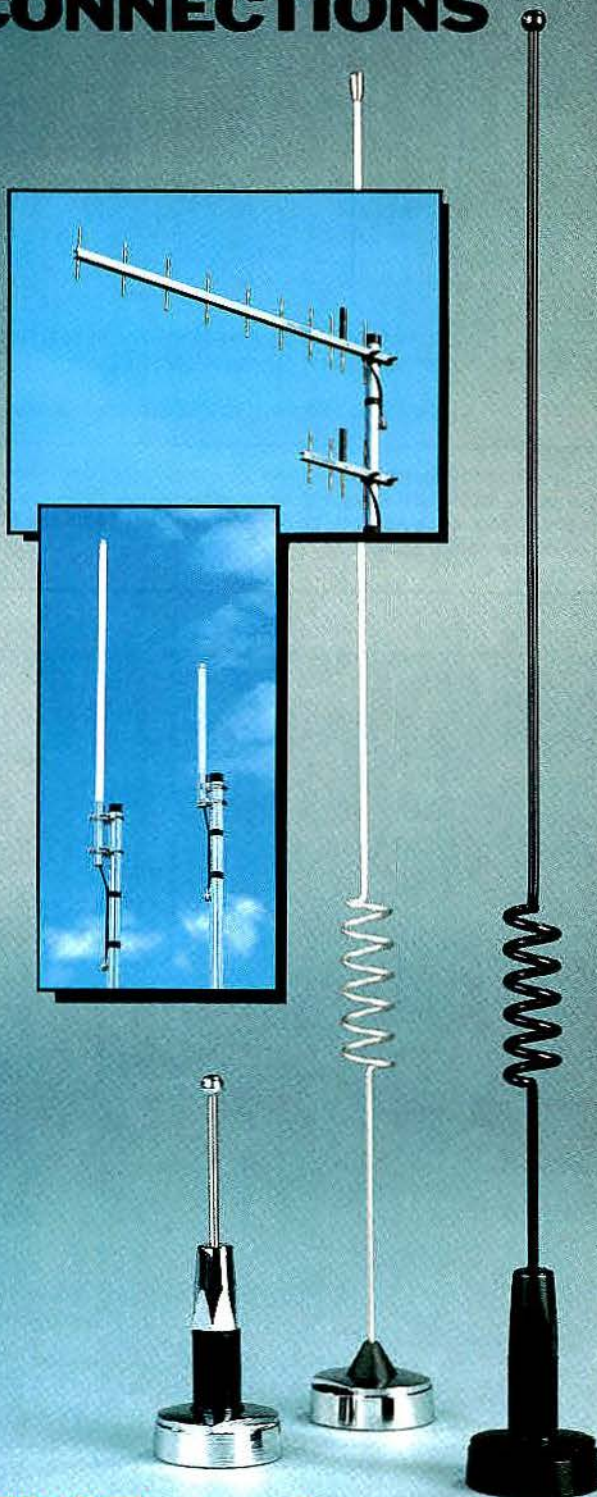
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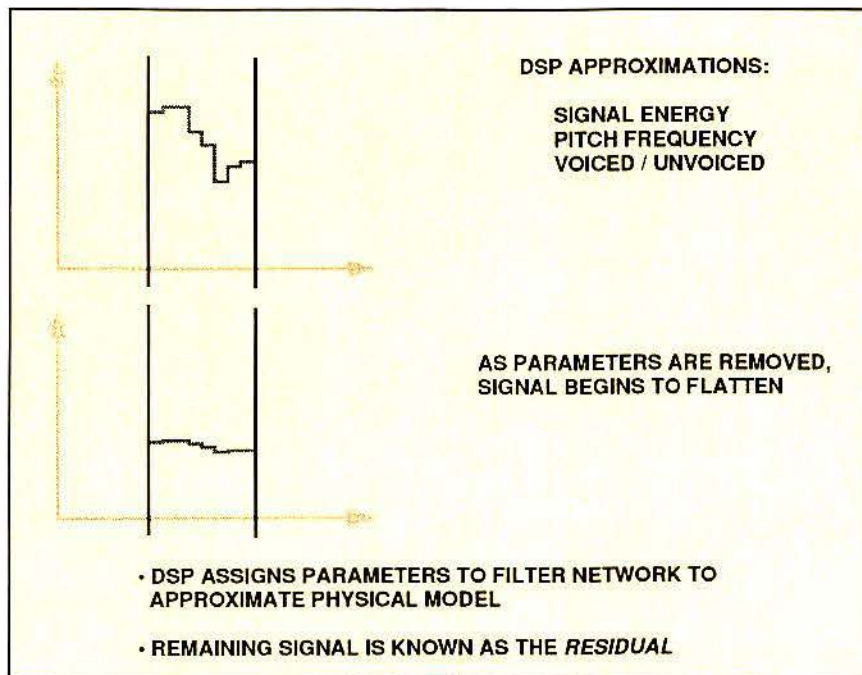


Figure 4. Linear predictive coding transmits filter coefficients that approximate speech patterns. Additional speech pattern information stored in the receiver is accessed by residual sequence address codes and combined with the filter coefficients to improve the digital audio quality.

pulses) for voiced sounds or air noise from the lungs for unvoiced sounds. Linear predictive coding derives coefficients for a filter structure that approximates this process.

The linear predictive coding process has several steps. (See Figure 4 to the left.)

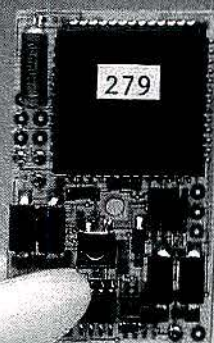
First, the analog signal is digitized using 64kbps PCM. This digital stream is divided into relatively short speech segments that the DSP processes. The DSP derives the filter coefficients that approximate the speech pattern and sends them to the transmitter.

Reconstructing the signal from these coefficients alone results in understandable, yet mechanical sounding, speech.

Audio quality improvements are achieved when the *residual* sequence, which is the difference between the input signal and the approximated signal, is transmitted. But transmitting the entire residual sequence results in a higher bit rate requirement, which in turn affects this method's efficiency.

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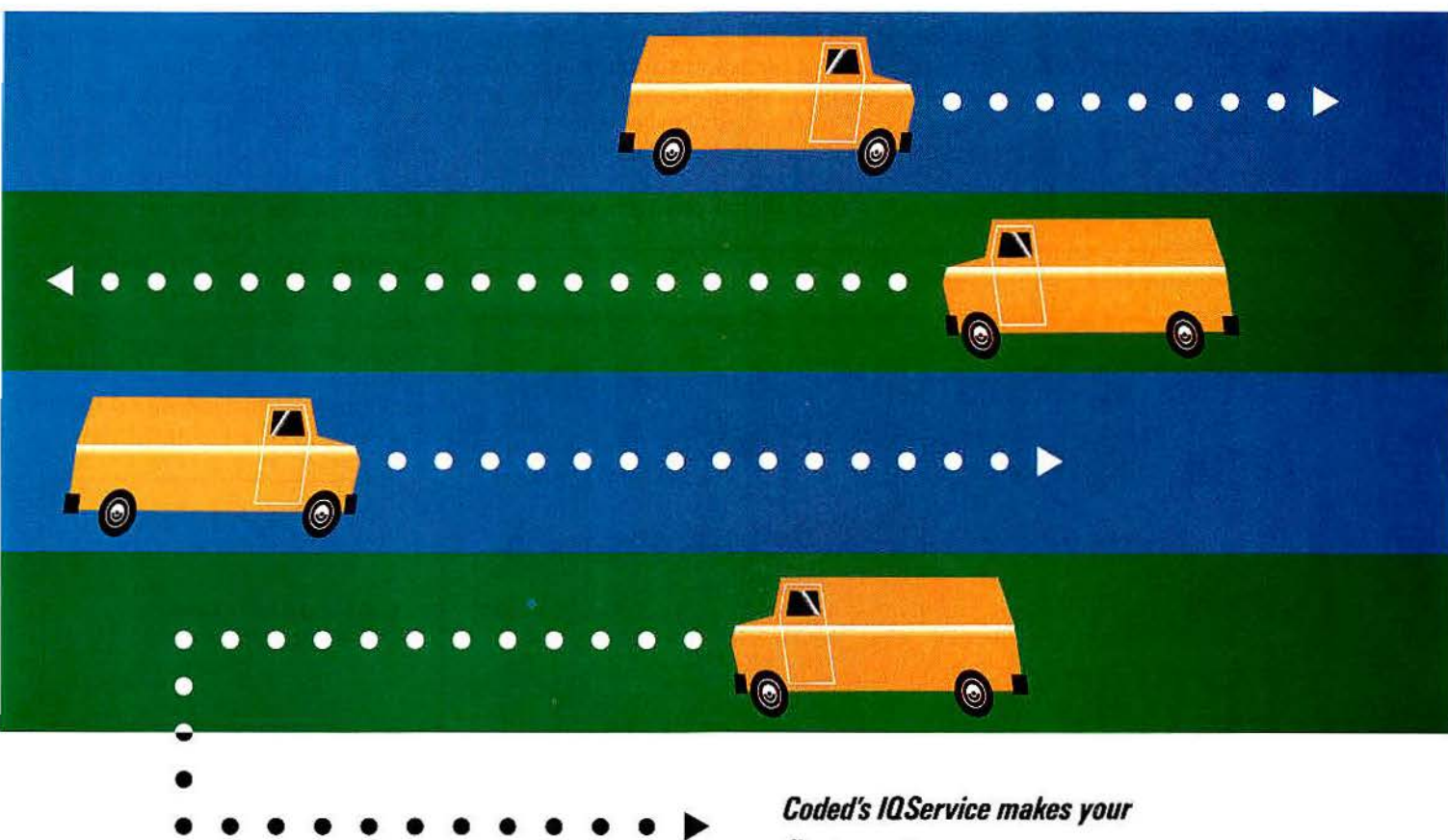
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residual sequences was derived. Instead of sending the entire residual sequence, only the residual sequence's address is transmitted. The receiving radio looks up the residual sequence in its electronic memory and adds it to the approximated signal.

Linear predictive coding requires approximately 4.8kbps of information to provide audio quality comparable to

analog. This information, when combined with new modulation techniques, easily fits a 25kHz channel.

In fact, there is much more room than what is needed to send just one voice over the channel. The additional capacity makes digital radio systems more spectrally efficient than their analog counterparts.

Three digital communications tech-

nologies, FDMA, TDMA and CDMA, are suited to different radio communications applications uniquely. The technologies differ in the way they make use of the additional capacity.

► **FDMA**—Frequency division multiple access (FDMA) offers more capacity than necessary to send one 4.8kbps digital voice over a 25kHz channel, so a smaller channel or a channel with less bandwidth may be used.

One implementation of FDMA technology uses a 12.5kHz-wide channel (half the bandwidth of previous channels) and provides the capability to create twice as many channels as 25kHz-wide channels from the same amount of RF spectrum. (See Figure 5 below.)

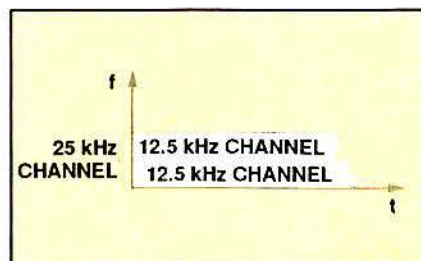


Figure 5. One implementation of FDMA technology uses a 12.5kHz-wide channel (half the bandwidth of previous channels) and provides the capability to create twice as many channels as 25kHz-wide channels from the same amount of RF spectrum.

Results of the FCC *Notice of Inquiry* concerning spectrum efficiency in land mobile frequency bands show that nearly two-thirds of respondents favor narrowband operation to reduce frequency congestion. The remaining respondents had no negative comments regarding narrowband FDMA.

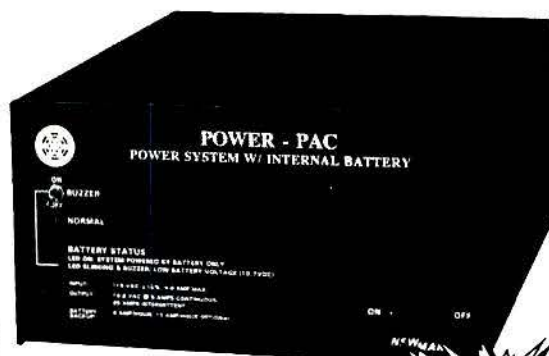
There are two methods of converting existing wideband channels to digital narrowband channels. (See Figure 6 on page 18.)

The *on-channel* method places narrowband digital channels on the existing 25kHz center frequency. When adjacent 25kHz channels have been converted to narrowband channels, the 12.5kHz space between them can be occupied by a new narrowband channel.

The *offset* method places two narrowband channels in the space formerly occupied by one wideband channel. The center frequencies of the two new channels are offset 6.25kHz to either side of the wideband channel center.

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Any benefit realized through channel-splitting or converting is contingent upon local and national regulatory guidelines.

FDMA techniques have been optimized for use in the land mobile environment. A 12.5kHz digital channel using QPSK-C modulation can transmit 9.6kbps of data while maintaining the required level of adjacent channel protection.

Site issues, such as transmitter noise and receiver desensitization, still must be evaluated (as they would be with analog technology).

Because only 4.8kbps is required to represent a voice, extra capacity is available.

The extra capacity can be used to send other information such as error correction codes to ensure high audio quality; system signaling to add new features and improve existing features; and encryption information to ensure secure communication.

In today's analog systems, voice and data contend for a channel. The signal-

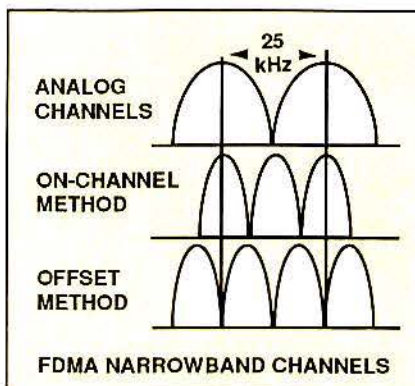


Figure 6. Converting 25kHz analog channels to 12.5kHz digital channels may be accomplished via the on-channel or offset method.

ing information is sent first, and the voice message follows. This process truncates the voice.

The digital system uses a process called *embedded signaling* that intermixes the extra 4.8kbps of signaling information with the digital voice.

Embedded signaling eliminates truncation and adds reliability into the sys-

tem by embedding system and radio information continuously through the duration of the voice message. Features such as encryption, emergency, unit ID, automatic power control and alphanumeric messaging may be realized and made more reliable by embedding the signaling in the voice message.

Data capacity increases significantly when the communication is entirely in a data mode. Field units operating in the data mode send as much as 7.2kbps of data and 2.4kbps of error correction. Not only can digital technology provide a dramatic increase in data capacity compared to today's analog systems, but the variety of data applications can be increased as well.

Error correction codes help to ensure data integrity, adding reliability.

FDMA systems can increase spectrum efficiency by 2:1, add new features, enhance existing features and increase data capacity along with providing high audio quality in trunked and conventional radio communications systems. FDMA systems can be used in any fre-

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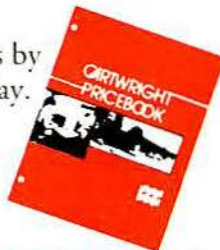
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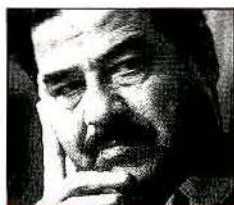
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quency band.

► **TDMA**—Time division multiple access (TDMA) uses a 25kHz channel's additional capacity to transmit multiple voice messages simultaneously. Spectrum efficiency is accomplished by splitting the channel into repeating time slots, each of which can carry the necessary information for one voice conversation. (See Figure 7 to the right.)

One TDMA access method splits the 25kHz channel into six repeating time slots, potentially enabling as many as six users or groups of users to share the channel at any time.

TDMA technology inherently provides multiple communications paths. To use these paths effectively, some control must be placed over path access and allocation to user groups. Trunked ra-

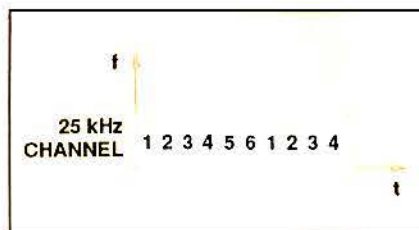
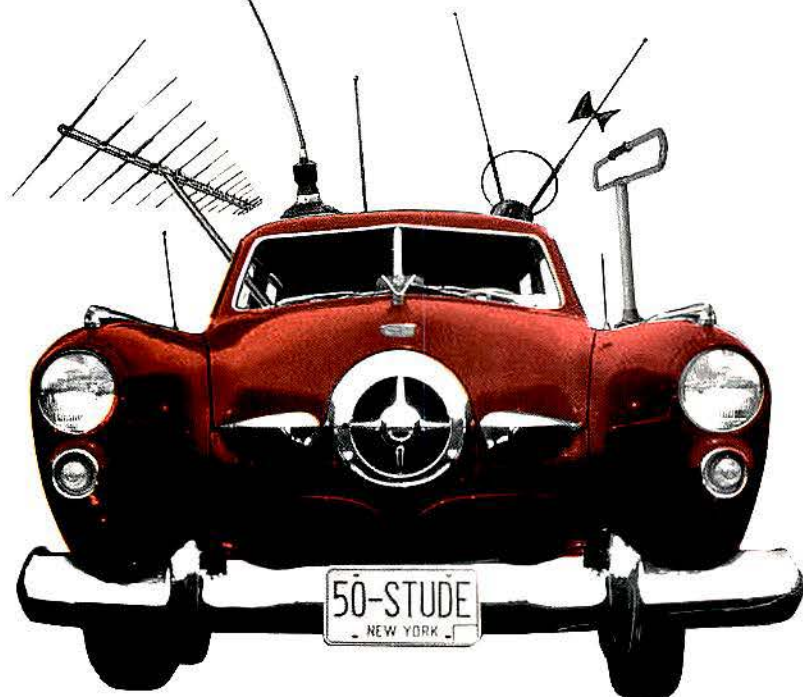


Figure 7. Time division multiple access (TDMA) uses a 25kHz channel's additional capacity to transmit multiple voice messages simultaneously. Spectrum efficiency is accomplished by splitting the channel into repeating time slots, each of which can carry the necessary information for one voice conversation.

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dio technology provides the control and dynamically assigns these talk paths to users upon request.

The TDMA modulation technique has been maximized for the land mobile environment, allowing digital channels to coexist with adjacent analog channels. Nonetheless, co-channel use is a spectrum issue that must be addressed.

The mobiles and portables in this type of system must be synchronized tightly for orderly talk path assignments. Any interference that causes errors in the outbound signaling could jeopardize this synchronization. Therefore, exclusive-use channels, such as those available at 800MHz, are strongly recommended for any TDMA communications system.

Because each user only transmits and receives one-sixth of the time, the transmitter and receiver each can be assigned a different time slot, allowing full-duplex telephone interconnect calls on mobiles and portables without the use of a duplexer. With TDMA, full-duplex interconnect becomes an inherent capability, resulting in added convenience and improved economy in telephone communications.

Systems using TDMA can support data and voice transmissions on one channel using different time slots.

For example, one individual could use one time slot for a voice conversation while another individual faxes documents on another time slot.

A new linear modulation technique, M-16QAM, transmits information at 64kbps over a 25kHz channel. The higher data rates allow data-intensive applications, such as facsimile, on a TDMA system.

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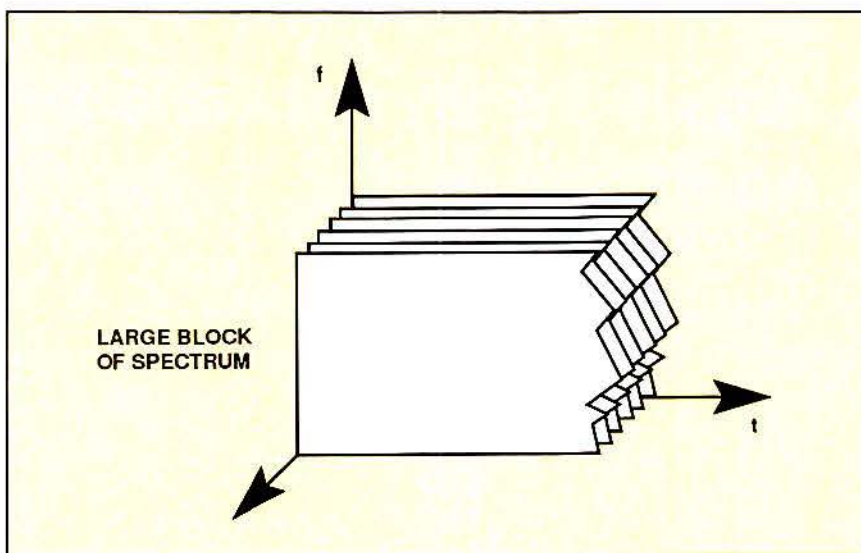


Figure 8. Code division multiple access (CDMA or digital spread spectrum) spreads the transmitted energy over a large amount of spectrum, using a low-powered signal that resists interference. Each transmission is coded so that CDMA receivers can separate the messages they are intended to receive.

Because of its dramatic increase in spectrum efficiency, TDMA technology is particularly useful in large

metropolitan areas where the radio spectrum is congested. TDMA's 6:1 increase in spectrum efficiency can help

to relieve overcrowding on some channels.

The technology will be useful in systems with many users sharing one RF backbone, such as specialized mobile radio (SMR) systems.

TDMA digital systems will offer full-duplex telephone interconnection, increased data capacity and high audio quality to improve trunked radio communications.

► **CDMA**—Code division multiple access (CDMA) technology uses even wider bandwidths than existing 25kHz channels to gain capacity. (See Figure 8 to the left.)

Also known as *digital spread spectrum*, CDMA spreads the transmitted energy over a large amount of spectrum, using a low-powered signal that resists interference. Each transmission is coded so that CDMA receivers can separate the messages they are intended to receive.

The combination of low-power signal and coding could allow many users to share the spectrum without interfering

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with one another. Nevertheless, each spread spectrum user generates some degree of interference to other users, which limits the number of users who can share a given amount of spectrum.

High increases in data rates could be possible due to the wider channel bandwidths. With CDMA's extremely wide bandwidth, even more data-intensive applications could be made possible. Fu-

ture CDMA implementation could make video transmission over radio communications channels possible.

CDMA's inherent low power requires many base station sites to cover even a relatively small geographic area. Coordinating a large number of sites for multi-radio group calls could bog down even the most advanced audio switches available today.

CDMA's low-power transmissions would have problems coexisting with present radio systems. Overlaying CDMA on existing spectrum would raise the noise floor for the existing users, resulting in reduced coverage and interference for those existing users.

Frequency coordination would be necessary to implement CDMA in land mobile radio to avoid interfering with existing users.

Migration

Although digital technology is a significant step in two-way communications, many users' requirements will continue to be met with analog technology for years to come.

Manufacturers must consider several migration alternatives to address the wide variety of existing analog systems. The goal is to trade out the analog system as required and maintain interoperability between analog and digital radios.

To complete a migration, users eventually will need to incorporate digital radio equipment in mobile and portable units, as well as a fixed "channel" infrastructure.

A migration must be equally flexible for single-site systems and large multi-regional systems. If a migration path is laid out properly, the analog-to-digital transition would add digital benefits where needed without disrupting an existing user's radio activities.

Summary

FDMA, TDMA and CDMA can offer land mobile radio significant improvements over today's analog systems.

Each of these technologies has unique applications. FDMA provides advanced new features and improves existing features, and it improves spectrum efficiency.

TDMA provides a dramatic improvement in spectrum efficiency, along with full-duplex telephone interconnect on all mobiles and portables.

CDMA has tremendous potential for improvements in features and spectrum efficiency, but still is in early stages of research.

An important element of any digital strategy is a migration plan. A well-planned migration allows users to implement enhancements provided by digital technology.



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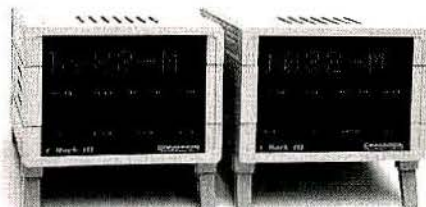
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CIMARRON TECHNOLOGIES

Microprocessor enables ultra-broadband transceiver

Microprocessor applications solve ultra-broadband FM transceiver design problems. Dynamic calibration virtually flattens deviation vs. frequency. A 'zero power' antenna coupler design is discussed.

By Richard L. Abrahams

Microprocessor-controlled synthesized FM transceivers are the mainstay of the radio communications industry.

Each successive generation of product offers an impressive array of new software-based "bells and whistles."

For example, some broadband transceivers cover the entire 26MHz-wide VHF highband from 148MHz to 174MHz with automatic receiver front-end tracking. These products operate over a 1.16:1 tuning ratio (i.e., $174\text{MHz} \div 148\text{MHz}$) or a 16% bandwidth.

Abrahams is president of Radio Systems, Ft. Lauderdale, FL. The company manufactures a portable transceiver used as an example in this article.

Attempting to extend this concept to cover a major portion of the military communications band, say 60MHz to 88MHz, reveals several design problems.

The major engineering challenge is that such a transceiver must operate with a 46% bandwidth, approximately three times that of the VHF highband unit. Such transceivers might be dubbed "ultra-broadband" to distinguish them from their broadband cousins.

Fortunately, microprocessor-based circuitry affords a rather neat solution to several pesky problems in ultra-broadband design. Compared to the latest version of military band hand-held transceivers, previous transceivers differ in several important respects:

1. They generally are in the 1W class

and do not contain an automatic antenna coupler. Rather, they rely on a broadband antenna design with low radiation efficiency. They are limited to approximately $\frac{1}{4}$ mile range and so-called "Squad Radio" applications.

2. They tend to be bulky and have been referred to, facetiously, as "two-hand-held" radios.

3. They lack some of the useful features considered standard in commercial transceivers, such as scanning.

4. They either require an external speaker or handset or have such poor receive audio quality with their built-in speakers that the use of a speaker is almost essential.

On the other hand, microprocessor enhancement has made possible a synthesized, 100-channel, 5W FM hand-held transceiver with continuous coverage from 60MHz to 88MHz. It offers high radiation efficiency over its entire band, thanks to its "zero power" miniature antenna coupler.

In contrast to Squad Radios, preliminary field trials with the transceiver have verified an effective range of much more than 1 mile between units, thus replacing vastly heavier and larger pack radios in many applications.

The transceiver is programmed via a serial bus device connected between the radio's remote audio connector and the RS-232 port of an IBM-compatible computer. Alternately, radios may be "cloned."

Dynamic calibration

To extend the tuning bandwidth to 46%, hyperabrupt varactors are used in the receive and transmit voltage controlled oscillators (VCOs) and in the re-

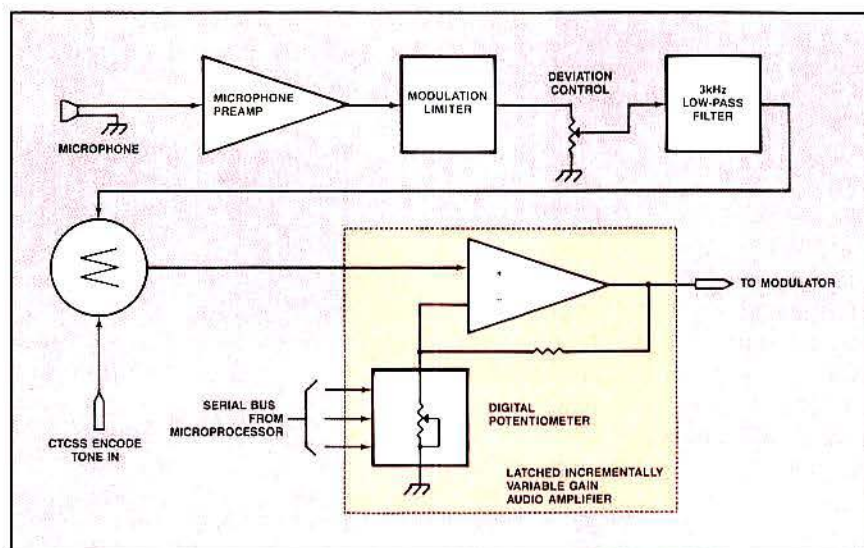


Figure 1. Because the previous transceiver design incorporates an embedded microprocessor and EEPROM, most of the necessary hardware already is present. The additional circuitry is a latched incrementally variable gain audio amplifier.

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ceiver front end tuned circuits.

Unfortunately, as these varactors tune the transmitter VCO over its band, unacceptably large changes in transmitter deviation occur.

To further complicate matters, a significant lot-to-lot spread in varactor characteristics often causes a variation of the degree of change of deviation vs. frequency. Deviation flatness historical-

ly has been a design problem in ultra-wideband transceivers.

Previous attempts at holding the deviation constant used a variable-gain amplifier in the transmit audio path. In some cases, a gain control signal was derived by nonlinear analog processing of the VCO tuning voltage.

Alternately, variable gain was provided by a metal oxide semiconductor field-

effect transistor (MOSFET) switched resistor network parallel-programmed from a fixed correction table stored in electrically erasable programmable read-only memory (EEPROM).

At best, these methods only approximated the ideal constant deviation vs. frequency characteristic.

A new approach was needed to flatten the deviation. The previous solutions did not take into account lot-to-lot varactor variations. Circuit board "real estate" and power drain were severe constraints.

The solution is dynamic calibration. It uses the transceiver EEPROM's storage capacity to house a table of deviation correction vs. frequency. The dynamic approach makes it possible to calibrate (i.e., "virtually flatten") each production radio individually for a constant deviation profile.

The transceiver is calibrated during the initial phase-up of the radio in production testing. The radio only needs recalibrating in the field if a critical VCO component is replaced.

Because the previous transceiver design incorporates an embedded microprocessor and EEPROM, most of the necessary hardware already is present.

Figure 1 on page 26 shows the only additional circuitry, a latched incrementally variable gain audio amplifier. This amplifier consists of an operational amplifier (really a section of a quad package) and a serial bus "digital potentiometer."

The digital potentiometer simulates a true potentiometer by providing 100 resistance taps from 0% to 100% of full resistance.

The amplifier and potentiometer are miniature low-current MOS devices. Because the transceiver's microprocessor already communicates with its peripheral chips via a serial bus, only one additional microprocessor I/O port is needed for the digital potentiometer.

The proper potentiometer setting for each channel is stored in the radio's EEPROM. When a channel is selected, the microprocessor reads the EEPROM and sets the transmit audio amplifier gain via the serial bus to yield the proper deviation.

Special software written for the IBM-compatible programming computer yields a calibration routine:

1. The programming computer reads

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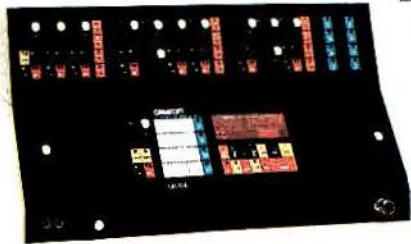
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channel information from the transceiver's EEPROM and temporarily stores it in its hard drive.

2. A special calibration file is loaded into the transceiver's EEPROM. This file programs specific calibration frequencies into the transceiver.

3. The calibration technician sequences the radio through its calibration frequencies, notes actual deviation at each frequency and inputs data to the programming computer.

4. The programming computer calculates a deviation correction table using an error algorithm and loads it into the radio's EEPROM along with the original channel data. These reloaded channels already are corrected for deviation.

5. When the radio is subsequently reprogrammed, the deviation correction table is read by the programming computer and used to virtually flatten the deviation on each channel.

Note that the deviation correction table is resident in a particular transceiver. No two transceivers have exactly the

same table.

6. If for some reason the programming computer does not find the radio's deviation correction table, the computer, after warning the programmer, loads a stock factory calibration table that

The antenna coupler, measuring only 3 cubic inches, contains four slug-tuned inductors.

generally yields acceptable, but not necessarily optimum, performance.

'Zero power' antenna coupler

Another challenge in ultrabroadband transceiver design is to provide high radiation efficiency over a large bandwidth.

The classical approach uses an antenna coupler to match the antenna at each frequency to 50Ω. This is all well and good for a 1 cubic foot, 15-pound pack radio, but how does one make the design miniature enough to fit a 1-pound hand-held transceiver?

Here again the microprocessor, EEPROM and programming computer come to the rescue. And again most of the hardware already is present in the transceiver.

The antenna coupler, measuring only 3 cubic inches, contains four slug-tuned inductors. Their inductance values are arranged approximately in binary increments, simulating a continuously variable inductor.

The resonant antenna impedance generally is below 50Ω mostly because of stray parasitic capacity in the antenna mount. Additional shunt L-C networks therefore are switched into the circuit in certain frequency bands to raise the resonant impedance.

The elements are switched in and out of the circuit by four TO-5 magnetic

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latching relays that are driven by the microprocessor through-current booster transistors.

Programming computer software stores antenna coupler settings vs. frequency tables for 8-inch rubber flex, 12-inch rubber flex and 30-inch tape antennas.

When channels are programmed in the radio, the proper antenna coupler setting for that particular channel is transferred to the radio's EEPROM along with the channel frequency, continuous-tone controlled squelch system (CTCSS) tone information and deviation correction information.

During operation, when a channel is selected, the microprocessor sequentially pulses the coupler's latching relays to place the proper elements in the circuit to tune the antenna. Each relay is pulsed for only 30mS and then latched—hence the name “zero power.”

A programming software option allows the 100-channel radio to be split into two 50-channel groups. The first 50 channels are programmed for the 8-inch

rubber flex antenna, and the last 50 channels are programmed for the 30-inch tape antenna.

Channels programmed into the low group are duplicated automatically in the high group. This option is particu-

The uniqueness of the relay approach is its ability to handle relatively high RF power.

larly useful if the transceiver has a dual mission wherein it would sometimes be used for local coverage but also might be used in more extended range situations (e.g., to contact headquarters).

How well does the antenna coupler

perform? Because of the short antenna length (approximately 1/24 wavelength at 60MHz) and the poor ground plane (consisting essentially of the radio operator's body), no hand-held radio antenna ever approaches the ideal radiation efficiency of a quarterwave monopole over an infinite ground plane.

A reasonable performance benchmark is to compare transmitted signal strength at a particular frequency to that of a fixed helical-wound flex antenna cut for the same frequency.

Lab tests show that the transmitted signal strength from the automatically tuned antenna is within 3dB of the benchmark antenna at any frequency in its band. It is approximately 13dB to 18dB better than a typical Squad Radio measured under the same conditions.

Conclusions

Microprocessor-based circuitry has become almost standard in a hand-held transceiver's design. As the performance of microprocessors, EEPROM and other peripheral devices continue to improve and their prices continue to fall, digital circuitry will continue to replace previously analog circuit functions.

Once a microprocessor is embedded in miniature devices such as hand-held transceivers, the incremental cost and “real estate” of expanding the microprocessor's role to controlling other blocks of circuitry is surprisingly small.

Although the illustration of calibration and “virtual flattening” relates specifically to correcting deviation vs. frequency, the principle is nearly universal. It could be extended easily to other circuit areas (e.g., correcting power output, and gain vs. frequency).

All that is needed is a controller in the signal path with a critical characteristic that may be varied in small increments by a serial bus.

Similarly, the “digital binary variable inductor” principle used in the antenna coupler may be extended to a variety of other adjustment tasks. The trick is to scale the smallest adjustment step to approach the performance of a continuously variable analog circuit element.

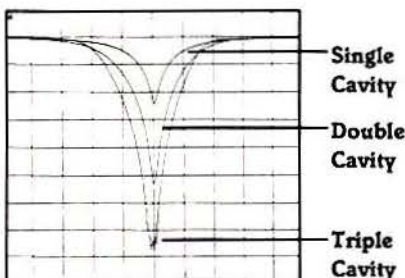
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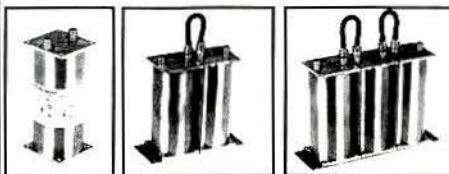
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1984:

Maxon introduces the CP-0520, a UHF version portable. Additional introductions this year — models CS-0510 and CS-0520 (the "CS-Series"), feature a hi-low power switch which selects 1 or 6 watt power output... adding a battery saving feature to a Series that still serves the field today!

1986:

Maxon goes synthesized (and mobile)! The SM-4150 is a 40 watt power. Three distinct models offer transmit/receive, transmit-only, and receive-only versatility.

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Maxon enters the telemetry/data market with the DM-0600 Series radio. house! With 16 programmable channels, and user friendly controls — this mobile will remain a favorite for years to come! Did we mention it took the "Most Innovative New Product" award when introduced to the market?

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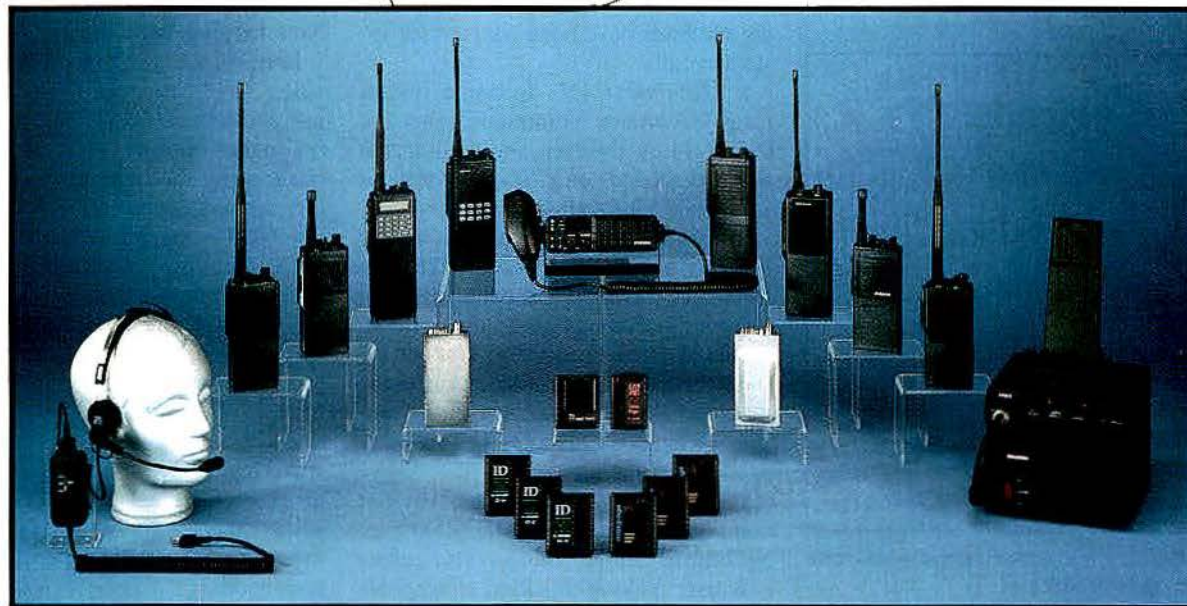
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Technology trends in logging recorders

Analog recorders have plenty of market to serve, though the trend favors digital recording and solid-state storage media. How rapidly storage media prices drop may control how fast the use of digital recording grows.

By Don Bishop
Editorial Director

Recorders help to document and interpret communications that pass through dispatching facilities.

Logging recorders that allow an individual dispatcher to review what was said during or shortly after taking a telephone or radio call are commonly known as instant recall recorders. They help dispatchers to understand unclear messages by replaying them as many times as necessary.

Other logging recorders store message traffic for extended periods to save as evidence, if needed, and to resolve disputes.

Years ago, audio cassette tape recorders were the only suitable instant recall technology.



An Omnicron Electronics audio cassette logging recorder.

Reel-to-reel tape recorders were the medium for long-term logging. Operating at slow speed, they record many hours of message traffic. Configured with multitrack heads, they record many channels simultaneously.

Today, cassette recorders serve as instant recall recorders and as long-term logging recorders.

Reel-to-reel tape recording technology has advanced to a point where some units record as many as 228 channels and as long as 100 hours per reel in a single cabinet and with a single controller.

Newer recording media have been developed that supplement or replace audio cassette and reel-to-reel tape recorders.

New instant recall recorders

Although audio cassette recorders continue to be used, two other recording methods have been adapted for instant recall.

► **Dynamic RAM**—In some instant recall recorders, communications are stored in a dynamic random-access memory (RAM) chip or other types of solid-state electronic memory.

Voices are converted from an analog form to a digital form and stored in solid-state memory. The dynamic RAM recorder's advantages over a cassette recorder are lack of moving parts and instant access to the recorded information without rewinding tape. Another advantage is the capability to record and play back simultaneously.

A disadvantage is the higher cost, but computer-type memory and chips are becoming more dense and cost-effective, making this kind of recorder

more practical.

► **Disk drive**—Other instant recall recorders use various forms of disk drives to store digitized voice message traffic. Floppy disks, hard disks and rewritable laser disks are used for this purpose.

Disk drives offer more memory for the dollar than dynamic RAM, and they have access speed comparable to solid-state memory, for all practical purposes.

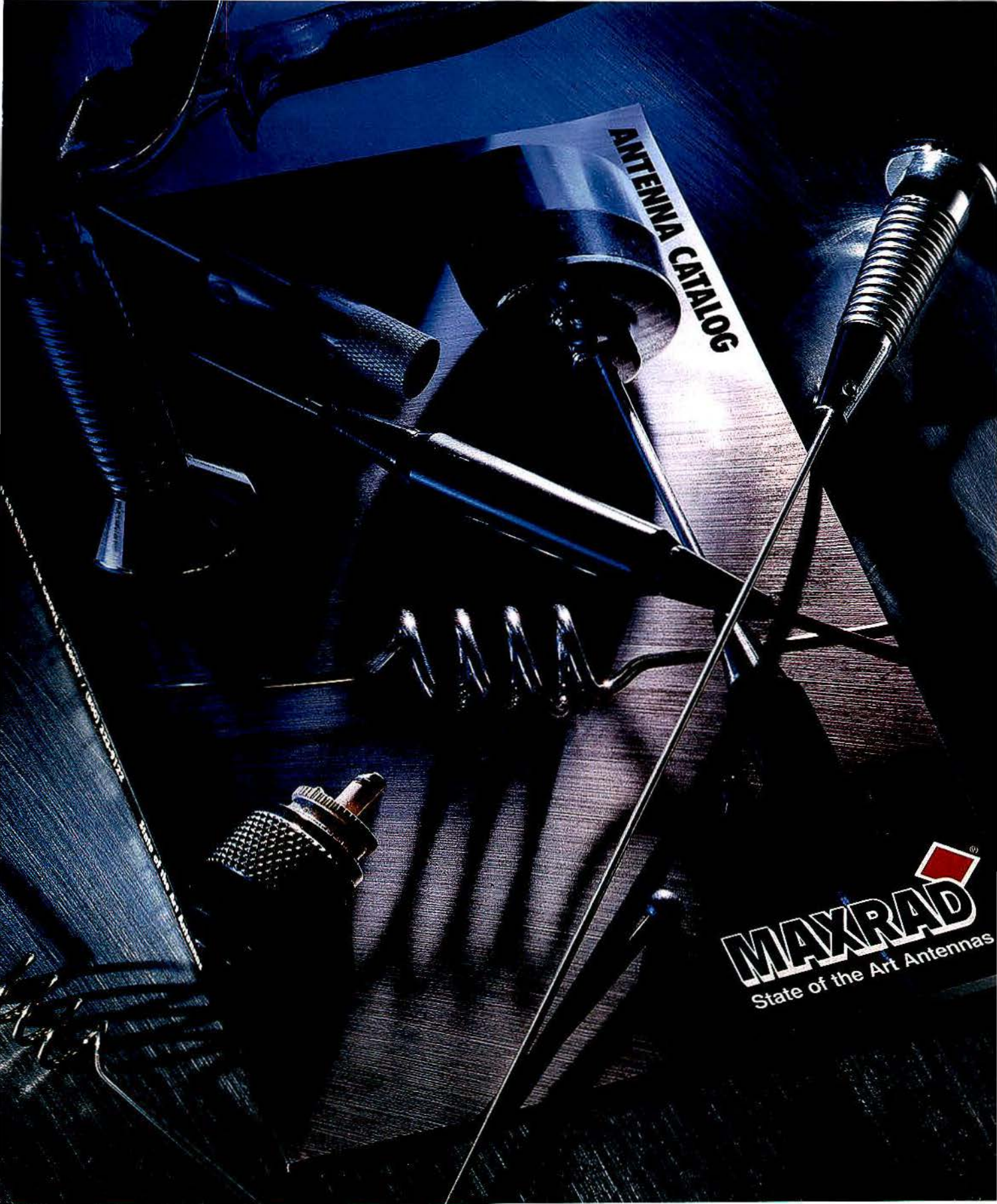
As solid-state memory and disk-drive memory become denser and less expensive, logging recorders that use them will replace more and more tape recorders beginning with low-capacity units. At present, dynamic RAM and disk drive recorders help to provide instant access to recorded information, and although high-capacity units are expensive, they are alternatives for long-term storage.

New logging recorders

Long-term logging recorders based on video cassette recorder (VCR) tape, digital audio tape (DAT) and rewritable magneto optical disk drives are challenging the domain of reel-to-reel logging recorders.

► **VCR**—Logging recorders that use VCR tape use recording techniques adapted from video or audio recording.

Santa Ana, CA-based Stancil uses the spinning, helical scanning recording head common to video recorders. "This method offers a higher bandwidth than would be available in traditional low-speed loggers," explained Michael Custer, Stancil's chief executive. Multiple audio channels are divided up and multiplexed for recording throughout that bandwidth.



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A Dictaphone digital audio tape logging recorder.

Irvine, CA-based Racal Recorders uses similar recording technology. Racal western region service manager explained that reel-to-reel tapes are expensive, compared to video cassette tape.

The Racal and Stancil units record as many as 32 channels for as long as 24 hours, depending on the type of tape used. "We can record 24 hours on a T-

160 cassette," Farooqi said of the Racal unit.

Teac America makes a video cassette logging tape recorder with linear tracking stationary recording heads instead of rotating heads. The unit records as many as 20 channels.

"Stationary heads offer more reliability, longer head life and more consistent

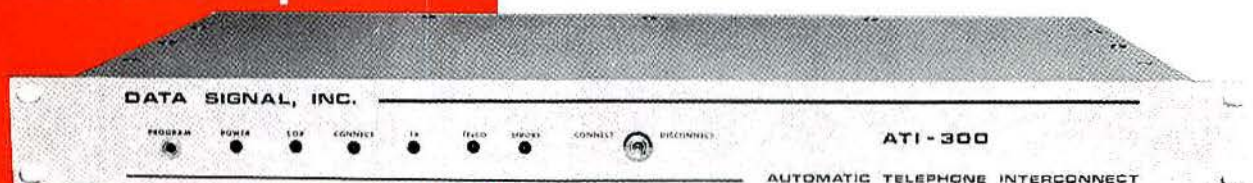
recording," said Bill Conway, field sales manager in the company's Montebello, CA, office.

ATIS, Roswell, GA, makes a recorder for VCR tape with stationary heads. Sales manager John Kemery cites greater head life as one reason for the fixed-head design.

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Surge:	200 watts	500 watts	1500 watts
Continuous:	100 watts	200 watts	500 watts
Input Voltage:	10 to 15 VDC	10 15 VDC	10 to 15 VDC
Output voltage:	115 VAC RMS \pm 5%	115 VAC RMS \pm 5%	115 VAC RMS \pm 5%
Output frequency:	60 Hz \pm 2%	60 Hz \pm 0.01%	60 Hz \pm 0.01%
Output waveform:	modified sinewave, phase corrected	modified sinewave, phase corrected	modified sinewave, phase corrected
Efficiency:	90%	90%	90%
Low battery alarm:	10.7 V	10.7 V	10.7 V
Low battery shutdown:	10 V	10 V	10 V
Dimensions (H x W x L):	1.2" x 3.5" x 4.5"	1.5" x 4.5" x 6"	3" x 9" x 10"
Weight:	14 oz.	1.25 lbs.	5.25 lbs.
Protection features:			
Over temperature:	Electronic shutdown	Electronic shutdown	Electronic shutdown
Overload:	Electronic shutdown	Electronic shutdown	Electronic shutdown
Short Circuit:	Electronic shutdown	Electronic shutdown	Electronic shutdown
Reverse polarity:	Fuse	Fuse	Fuse

Circle (33) on Fast Fact Card



A Teac America video cassette logging recorder.

own tape drive. Kemery said the video cassette logging recorders are smaller and consume less power than their reel-to-reel cousins.

Tape cost is a factor, too. "Reel tape costs as much as 10 times more than video cassette tape," Kemery said. "A T-180 tape records as much as 27 hours of information."

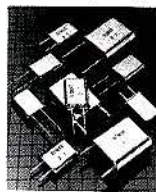
Video cassette logging recorders can be stacked to add channel capacity and configured to operate sequentially to extend operating time between tape changes.

"People like video cassette tape because the units are easy to use compared to threading reel-to-reel tape," Conway said. "No training is necessary."

► **DAT**—Stratford, CT-based Dictaphone offers one of the newer logging recorder technologies that uses digital audio tape.

The DAT recorder stores information in a compressed format instead of a linear format as with analog recorders. "It records a lot of information in a small package," said Terry Horn, Dicta-

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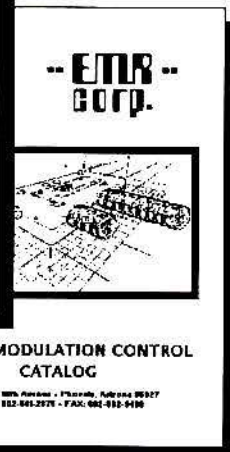
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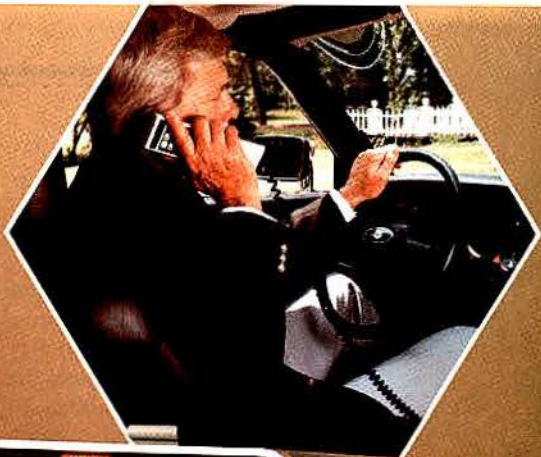
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phone's manager of technical services. As much as a year's worth of tapes fit a shoe box-sized space.

In addition, the DAT recorder writes an index of information it records. When searching for information to play back from a specific date and time, the recorder reads the index instead of searching the entire contents. "Search sequences take little time," Horn said.

"It is almost instant access."

Horn said that the DAT recorder's price may keep it from replacing analog recorders altogether. Dictaphone's analog fixed-head reel-to-reel dual-capstan recorders cost less.

The DAT recorder can serve as an instant recall recorder because of its quick access time. Dual deck configurations allow instant recall without interrupting

the master logger.

Horn said he expects the digital product to have as much as 300% better mean time between failure figures because it contains more packaged semiconductor units than the analog units.

Racal offers digital recording on a hard disk and DAT archiving.

► *Magneto optical disk*—One of the latest technologies to support logging recorders is the magneto optical disk rewritable drive from Magnasync, Hollywood, CA.

Randy Paskal, the company's vice

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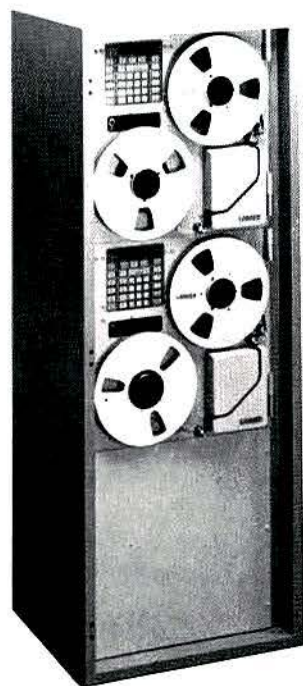
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A Lanier Voice Products reel-to-reel logging recorder.

president, said that the digital-based recorder combines a computer hard disk drive with the magneto optical disk drive that stores as much as four days of message traffic.

The disk combines magnetic and optical properties in a cartridge. Its magnetic properties allow it to be demagnetized while a laser burns the information on the disk. "It is similar to a compact disc," Paskal explained.

The important difference is that a compact disc only can be recorded once, but the magneto optical disk can be re-recorded as many as 1 million



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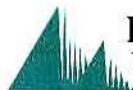
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times. Its life expectancy is 30 years. The disk uses a laser to search for data, so the response is immediate.

The computer hard disk drive acts as a buffer to the optical disk with as much as 30 hours to 180 hours of storage capacity with four channels to 80 channels on a typical system. The hard disk drive has instant access and serves as an instant recall recorder. It records and

plays back at the same time, so instant recall does not interrupt recording.

Other technologies

Despite the introduction of new technologies, analog recording on reel-to-reel and audio cassette tape continues to suit many logging recording applications.

► Reproduction Technologies, Bristol, IN, offers both types of recorders. The

company's reel-to-reel recorder runs 24 hours on a 10.5-inch tape.

Its cassette recorder runs at standard cassette speed and records a maximum of four channels for 120 minutes with VOX for extended recording, according to Maxine Beasey, the company's market operations manager.

► ATIS makes audio cassette and reel-to-reel logging recorders, as well as an instant recall recorder with solid-state memory.

► Magnasync makes reel-to-reel logging recorders for 10 channels to 240 channels.

► Lanier Voice Products, Atlanta, offers audio and video cassette, reel-to-reel, dynamic RAM and networked

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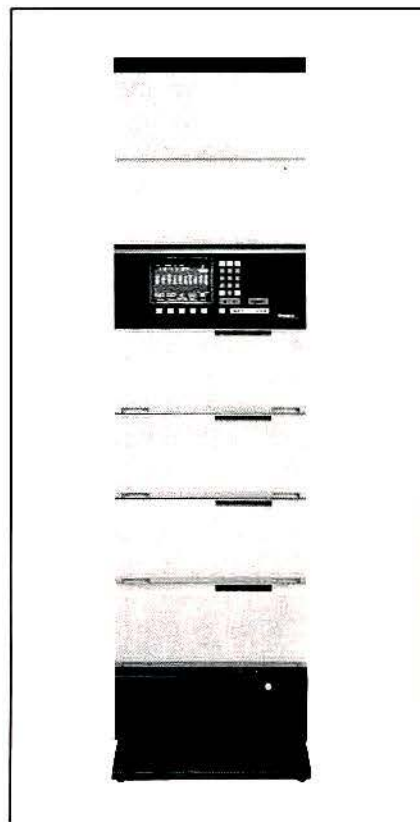
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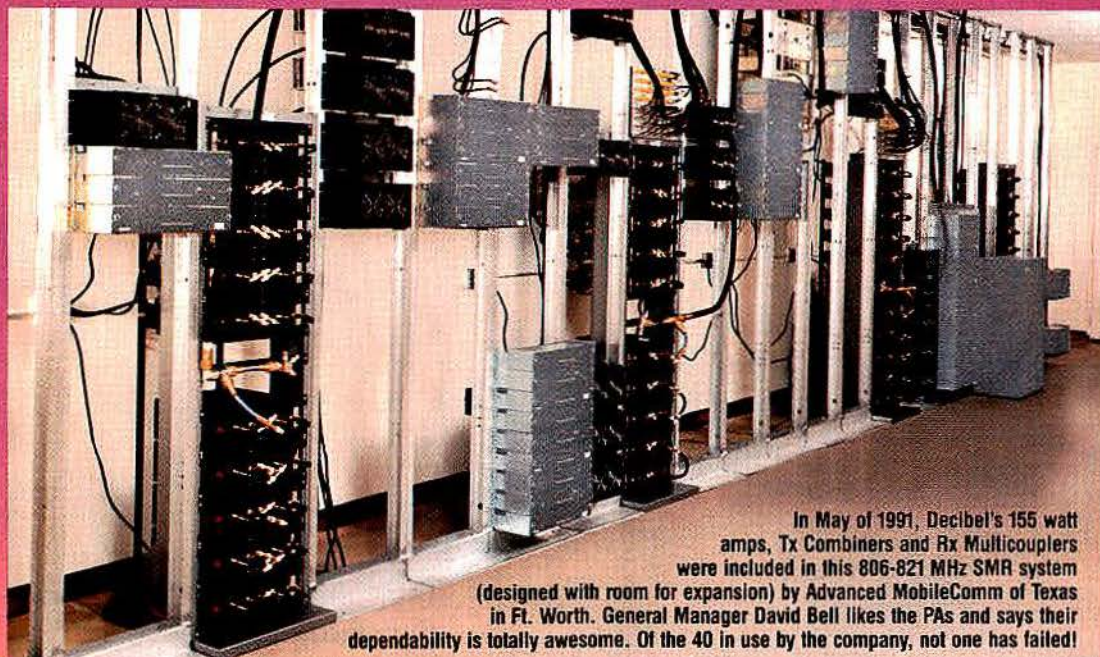
A Dictaphone reel-to-reel logging recorder with multiple concealed tape drives.

hard-disk-based instant recall and logging recorders.

► Omnicron Electronics, Putnam, CT, specializes in audio cassette logging recorders.

William E. Jones, Omnicron's general manager, said his company's products normally are used to record one operator position at standard cassette speed

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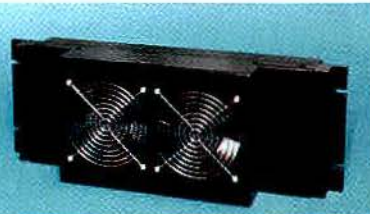
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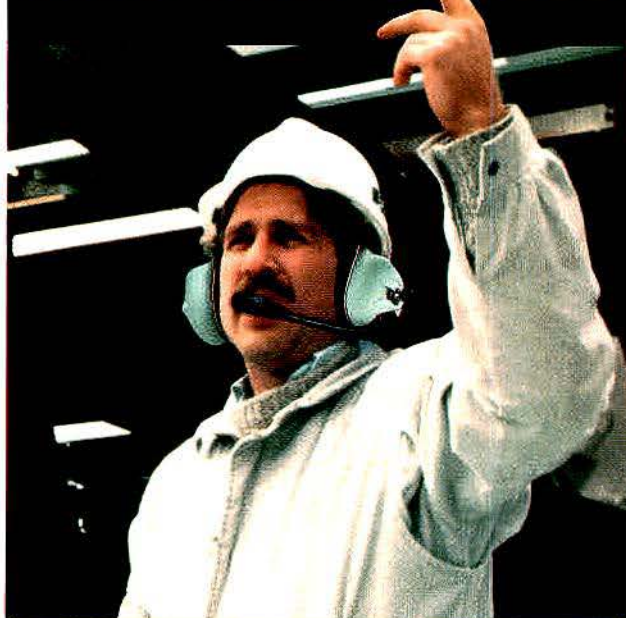
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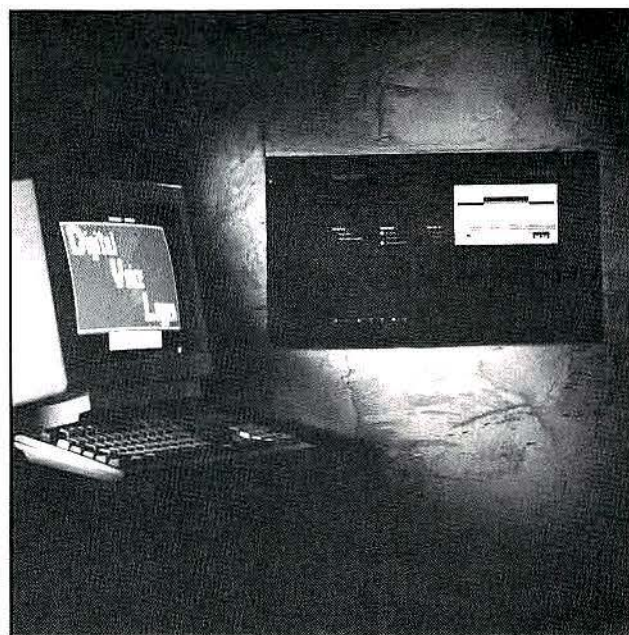
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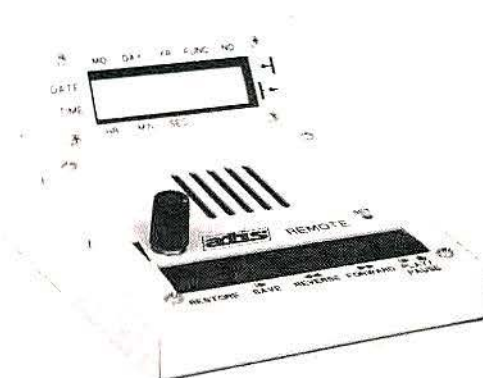
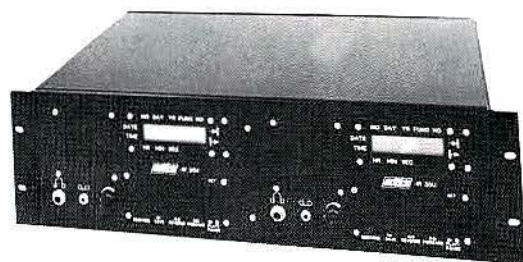


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Magnasync's digital logging recorder.



The ATIS rack-mount instant recall dynamic random-access memory (RAM) recorder and its remote control unit.

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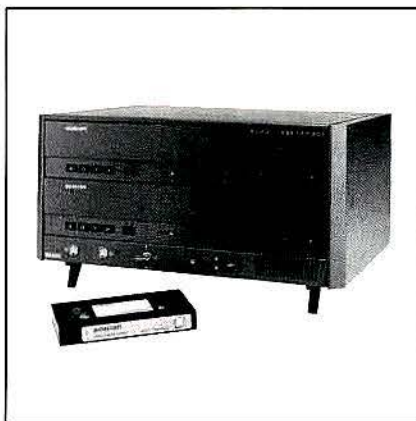
or at $1/4$ or $1/8$ the standard speed. The units run only during conversation to extend the time between tape changes.

The units are about the same size as a facsimile or answering machine. Jones said users can connect the units to telephone lines or other instruments themselves, eliminating the need for on-site service by trained technicians.

Jones recommends using audio dictation cassettes because they have recordable leader tape; general purpose cassettes have plastic leader that does not record. At slow speeds, cassettes with plastic leader may miss the first words or sentences at the beginning of the tape.

► AM/COMM Systems, San Francisco, makes single-channel instant recall and four-channel audio cassette logging recorders licensed under a 3M patent.

Company president John Ohmura said the units run at $1/4$ or $1/6$ standard cassette speed to record as much as six hours per tape. The units are activated by contact closer, VOX or voltage-



A Racal Recorders video cassette logging recorder.

sensing interfaces, so they operate only when communication is taking place.

The units use direct-drive motors that are wound onto their circuit boards.

The time and date code is superimposed digitally on the audio with subaudible tones, making it virtually impossible to alter a tape undetectably.

► Accurate Sound, Menlo Park, CA,

offers audio cassette and instrumentation reel-to-reel logging recorders.

The cassette unit records four channels or eight channels in one direction for as long as eight hours continuously or longer under VOX control.

The reel-to-reel unit records on as many as eight channels for as long as 100 hours on a 10.5-inch reel. The recorder logs signals in direct FM or PCM at speeds from $15/32$ ips to 30ips.

Ron Newdell, the company's sales manager, observed that most people want a logging recorder with at least 24.5 hours running time so tapes do not have to be changed more than once a day.

"To satisfy that demand, we are developing a new system that will log one channel for 24 hours on a C-90 Philips cassette," he said. The new recorder is expected to be available by the end of the year.

What's ahead

Stancil's Michael Custer said the trend toward digital recording points the

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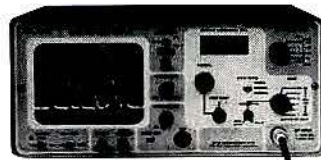
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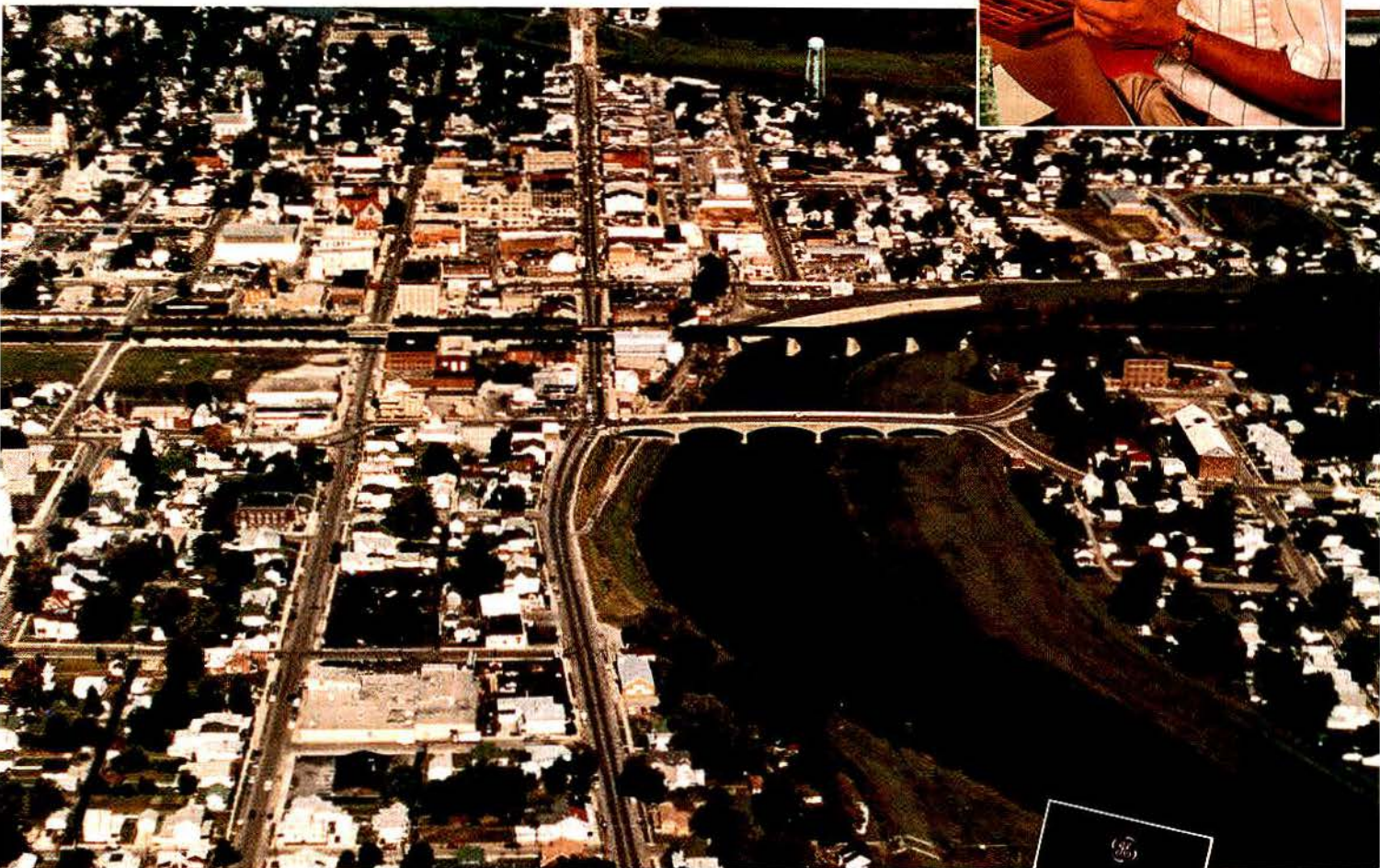


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How Lonnie Harper of Lynchburg, VA, helped Miami County of Ohio control an explosive situation.



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way to the future.

"Reel-to-reel recording is retaining its cost-effective advantage only at higher capacities where many channels have to be recorded and stored for a long time," he said.

"As the cost-per-channel drops and the length of memory for digital recording increases, analog tape recording will be replaced at ever-increasing capacity levels," he said. At present, though, Custer said reel-to-reel recording is clearly more cost-effective at the highest multichannel capacities.

"But when 32 channels can be recorded for 24 hours on a \$10 tape, that is appealing," he said, referring to video cassette logging recorders.

Custer predicted that digital logging recorder technology will use various recording media, including new types of solid-state memory yet to be developed. The difference will be in the recorder manufacturer's analog-to-digital conversion and digital compression techniques and in software.

"With digital recording, we have a lot

of leeway in manipulating data to maintain good voice quality while minimizing the amount of memory required for storage," he said.

Various technologies fit diverse ap-

plications ranging from recording a single telephone line to recording multiple telephone and radio circuits, with the trend being toward digital recording and solid-state memory.

Logging recorders

For more information about logging recorders, circle the corresponding numbers below on the Fast Fact Card in the back of this issue.

Accurate Sound

Circle (400) on Fast Fact Card

AM/COMM Systems

Circle (401) on Fast Fact Card

ATIS

Circle (402) on Fast Fact Card

Dictaphone

Circle (403) on Fast Fact Card

Lanier Voice Products

Circle (404) on Fast Fact Card

Magnasync

Circle (405) on Fast Fact Card

Omnicon Electronics

Circle (406) on Fast Fact Card

Phonetix

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Racal Recorders

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Reproduction Technologies

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Spilsbury Communications

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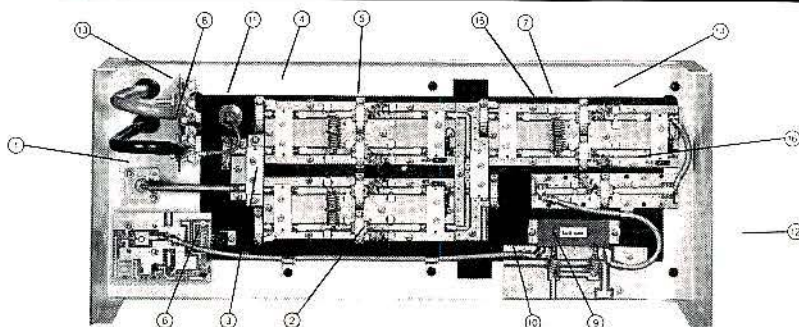
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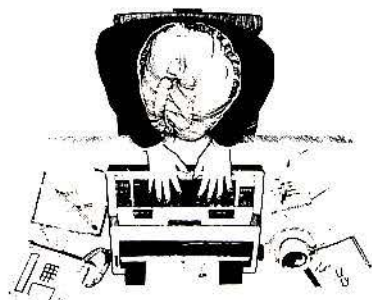
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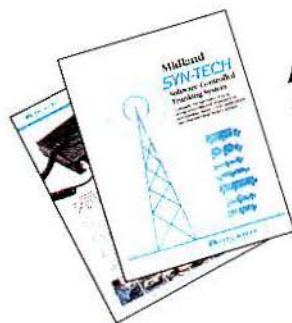
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Circle (48) on Fast Fact Card



Use pressurization to protect RF feedlines

Pressurized nitrogen or dehydrated air protects valuable RF transmission lines from moisture that may enter at connectors, joints and punctures. Here are advantages and disadvantages of various methods.

By Lloyd A. Keyser

Air-dielectric transmission line performance can be reduced greatly when filled with ambient air. Under sealed conditions, moisture in the air can condense inside the transmission line when the ambient air temperature reaches the contained air's dewpoint.

All air-dielectric coaxial cable and waveguide should be maintained under dry gas pressure to prevent corrosion.

Keyser is business unit manager for the pressurization product line at Andrew Corporation, Orland Park, IL.

voltage breakdown and increased VSWR from degrading its electrical performance.

Dehydrator pressurization equipment can protect antenna and transmission line systems from the effects of moisture penetration.

Moisture's effects

Air-filled transmission lines, unless pressurized, allow moisture to enter through joints. Joint seal elastomers have a calculable leak rate that increases as the system ages.

Ballistics penetration of a line (through vandalism) allows copious amounts of water to enter unless the line

is maintained under pressure.

► **Corrosion**—If a positive dry air pressure is not maintained inside the lines, "breathing" allows moist air to enter through joints. (See Photo 1 below left.)

This moist air, under lower temperatures, condenses on internal surfaces of transmission lines and fittings and causes corrosion. Corrosion increases attenuation and permanently or intermittently degrades system performance.

► **Voltage arcing**—A transmission line may fail because dust and moisture create conductive pathways between inner and outer conductors. (See Photo 2 below.)



Photo 1. Moisture in a transmission line can cause corrosion that increases attenuation and reduces system performance.

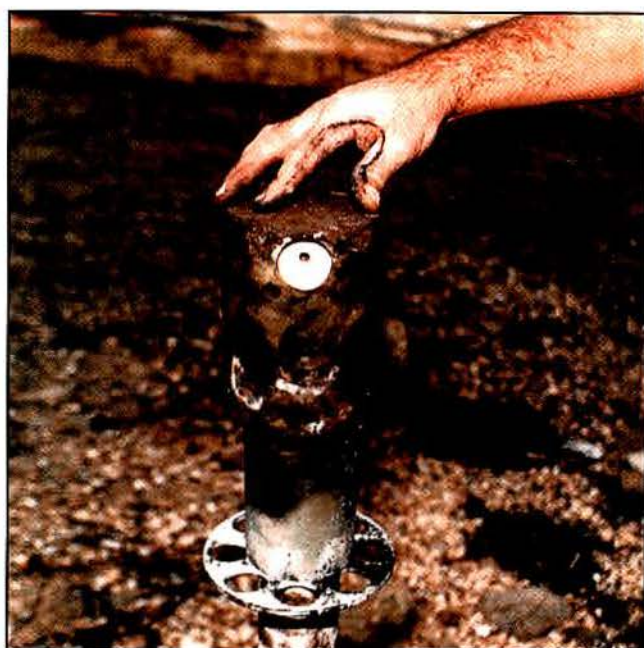


Photo 2. Burned Teflon shows the conductive path formed by dust-laden moisture. As the path arcs over, the transmission line fails.

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MESSAGE: GOT YOUR MESSAGE!
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RECEIVED BY: [Signature]



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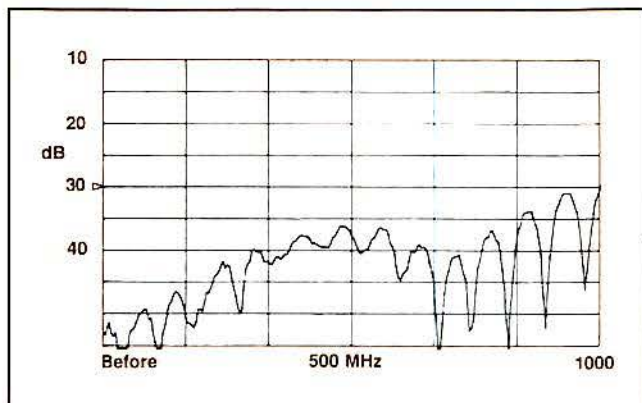


Figure 1. Transmission line return loss before water drop.

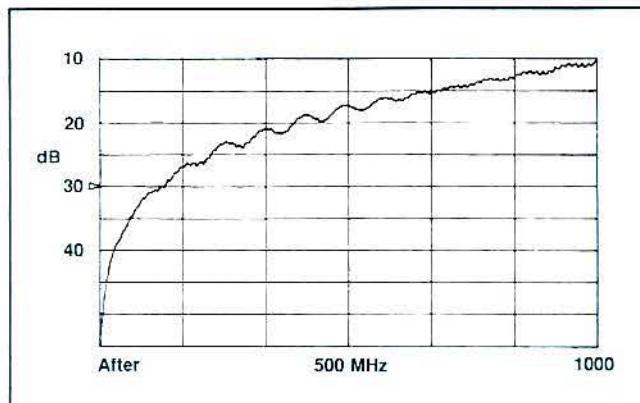


Figure 2. Transmission line return loss after water drop.

Dust-laden moisture repeatedly deposited on the horizontal surface of an insulator builds a conductive path as the moisture evaporates. As the conductive path arcs over, transmission line failure occurs. The transmission line then must be pulled and cleaned, and the damaged parts must be replaced before full power is restored.

► **Increased VSWR**—Water deposited

on horizontal insulators and on the waveguide's bottom surface causes increased reflected power. It degrades system performance and eventually results in transmitter shutdown.

Figure 1 above shows the return loss of a length of a 3-inch air-dielectric cable before water is introduced. Figure 2 above shows the cable's return loss after 3cc to 4cc of water is introduced and

collects at the bottom connector. Performance degradation is severe.

Design considerations

Condensation in transmission lines depends on the amount of moisture in the contained air, expressed as dewpoint or relative humidity (RH), and the outside air temperature. Dewpoint and relative humidity are defined as follows:

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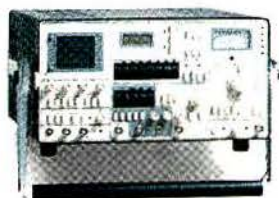
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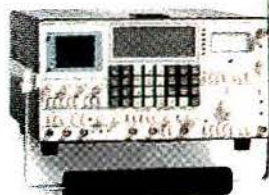
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WAVETEK

Dewpoint is the temperature at which saturated air above freezing condenses in the form of water droplets on a colder surface. If the temperature is below freezing, ice crystals precipitate out of the air.

Scientific language: When the partial pressure of the water vapor equals the saturation partial pressure of the water, moisture condenses on a cooler surface.

Relative humidity is the ratio of the actual vapor pressure to the saturated vapor pressure.

Dewpoint and relative humidity are affected by temperature and atmospheric pressure. Dehydrators remove specific amounts of water at a specified maximum relative humidity and temperature to provide air at a specific minimum dewpoint.

Outside ambient temperature changes require special consideration. The dry gas supply system must be sized to maintain transmission line pressure when the outside ambient temperature drops at rates as high as 50°F per hour.

Similarly, because the transmission

line pressure increases when the ambient temperature and solar load on the transmission line increase faster than the leak rate, gas barriers and feed horn windows must be protected with a high-pressure relief valve. Overpressure may distort some antenna types.

Pressure drop

The pressure drop in the gas feedline from the dehydrator to the transmission line depends on feedline length and diameter.

Often, pressurization systems are installed with feed tubing that has a diameter too small for the distance from the dehydrator to the manifold or the manifold to the transmission lines.

Quarter-inch feed tubing is not recommended because most installations exceed its recommended maximum length. Most communications systems can use as much as 300 feet of 3/8-inch feed tubing. Large-capacity broadcast systems can use as much as 500 feet of 1/2-inch feed tubing without performance degradation.

The system pressure drop is related directly to equipment sizing and installation workmanship.

Dehydrators are pressure-tested at the factory to ensure leak-free operation. Nevertheless, improper or sloppy feedline installation results in kinks in the lines and leaks in compression fittings.

Protecting transmission line flanges when the lines are installed in towers and buildings is critical. The flanges should not have any nicks, gouges or raised burrs on their edges and surfaces.

Check to see that gasket grooves are free of debris and flange seals are smooth with no nicks and cuts.

Flange bolts must be torqued evenly to the prescribed values.

A high-quality installation is a low-maintenance installation.

Gas supply selection

The gas supply may be a bottle or, more commonly, a pressurization system.

Bottled gases normally used for pressurization are nitrogen (N₂) and sulphur

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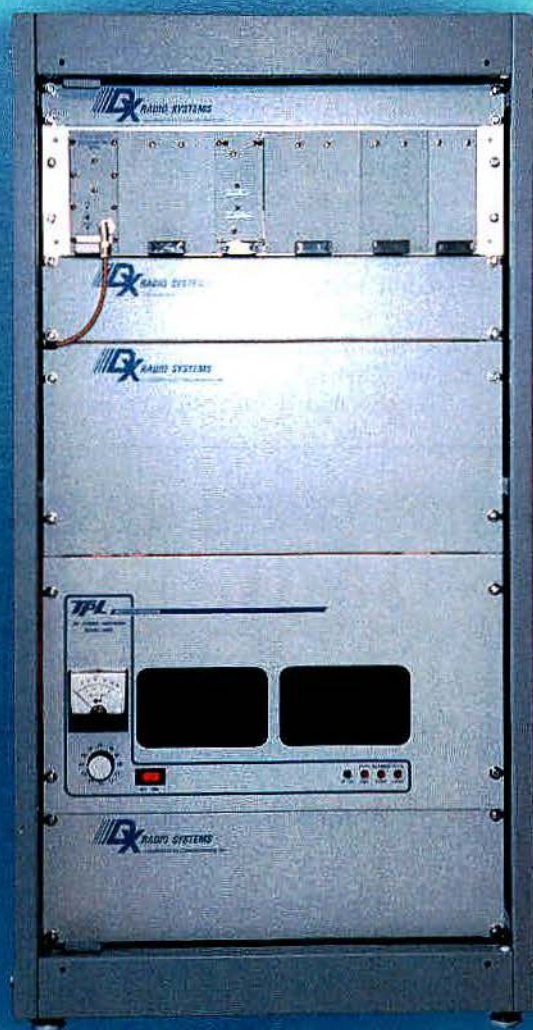
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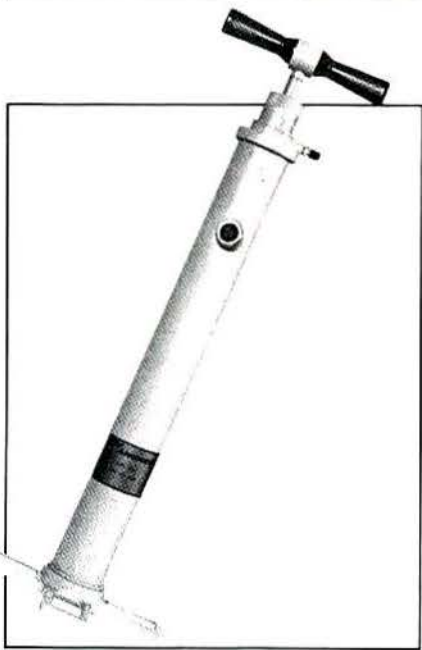


Photo 3. In static pressurization systems, transmission line often is pressurized by a hand pump.

hexafluoride (SF_6), which have dewpoints from -70°F to -100°F , depending on the process implemented.

Pressurization systems can be classi-

fied as static or dynamic. In a static system, the transmission line is pressurized by a hand pump or other means. Then the pressurization source is removed.

Transmission lines are not hermetically sealed. Thus, static systems eventually lose pressure. They require periodic recharging and should not be used where the site is not regularly and easily accessible.

Hand pumps are used on small, tight systems, and they can supply as much as 135scf of dry air under ambient conditions of 40% RH and 70°F (21°C) before regeneration is required. The advantages of hand pumps include portability and simple operation. The disadvantages are that they require manual regeneration of the desiccant, and they provide for a low purge and low system volume. (See Photo 3 at the left.)

Dynamic system

A dynamic system incorporates a pressurizing source that provides dry gas on demand.

The pressurizing source may be nitro-

gen tanks with a regulator or an automatic dehydrator. The source is connected to the transmission line system permanently and recharges it to a preset positive pressure as required to compensate for leakage losses. This method provides positive pressure at all times. (See Figure 3 on page 58.)

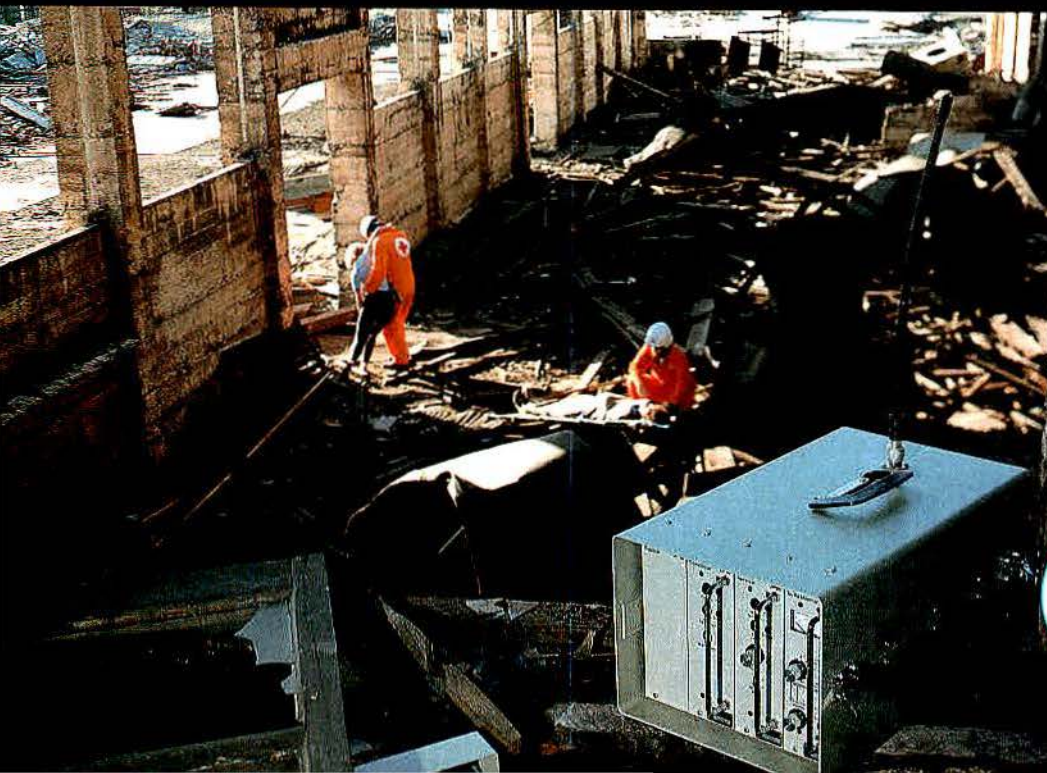
Nitrogen tanks mainly are used on small, tight systems and where public utility ac power is unavailable.

Using nitrogen is advantageous because its dewpoint is lower than dehydrated air; there are no power requirements; it has no moving parts; and the gas itself costs little.

Nonetheless, overall costs are not as economical as it might seem. Hidden costs include monitoring tank pressure, ordering additional tanks, overseeing site access and delivering gas during bad weather. Other hidden costs include low purge volume, limited capacity (only minutes) in the case of ballistics vandalism and a complex piping system.

► *Manually regenerative dehydrators* require frequent inspection and periodic

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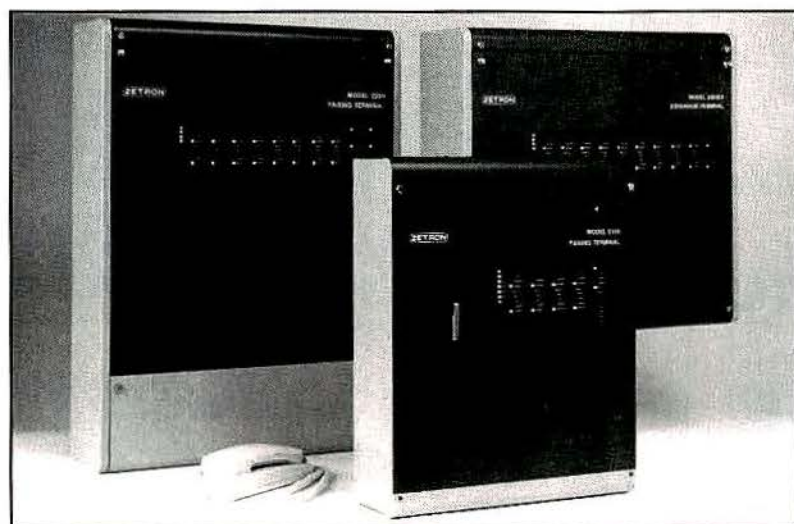
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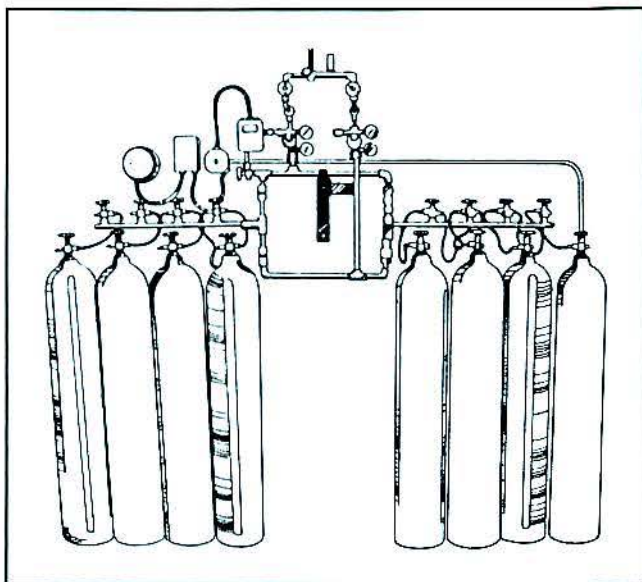


Figure 3. Dynamic pressurization systems often use nitrogen tanks as a pressurizing source.



Photo 4. Desiccant type dehydrators are manually regenerative, requiring frequent inspection and periodic replacement or regeneration of the desiccant.

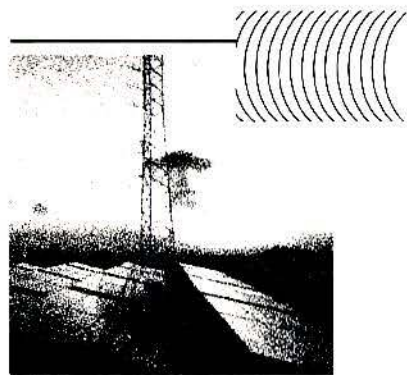
replacement or regeneration of the desiccant. (See Photo 4 above right.) Regeneration frequency depends on the

system's leakage rate.

Manual units can supply as much as 270scf (7,646 liters) of dry air under the

ambient conditions of 40% RH and 70°F before regeneration is required. Their advantages include automatic dry-

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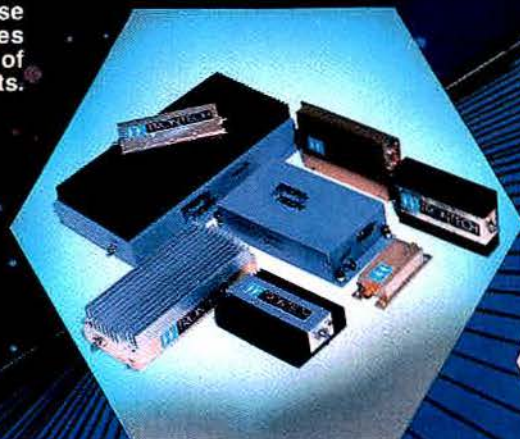
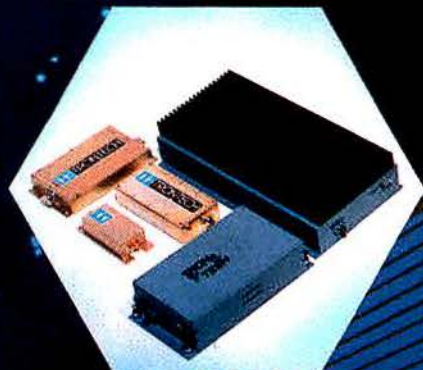
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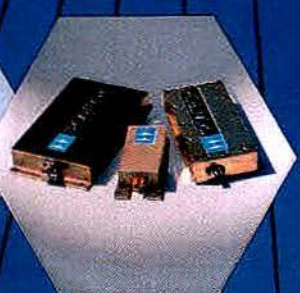
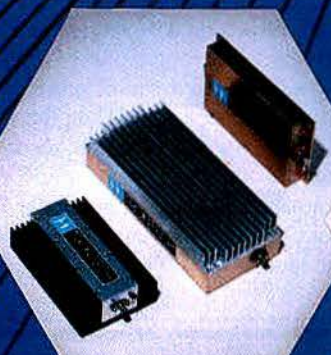
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High power linear	400 — 1000 MHz	Amplifiers up to 80 Watts Linear for transmit applications
High power linear	1.7 — 2.3 GHz	GaAs Power Amplifiers for Cellular Radio Microwave Links

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ing, low power requirements, a 10-year to 15-year life expectancy, economical operation and simple installation. Maintenance is more economical than with nitrogen tanks that have to be changed.

The disadvantages are that manual units require manual desiccant regeneration and ac power. The units have moving parts, low purge and system volume, and the compressor unit makes noise.

Desiccant may be replaced at the site during monthly or quarterly inspections. Saturated desiccant can be reactivated by baking it for four hours in an ordinary oven at 350°F (180°C) during dehydrator downtime. Alternatively, it can be replaced by new desiccant and discarded, or replaced by new reactivated desiccant and saved for reactivation at a more convenient time and place.

Heat regenerative dehydrators can range in size from a small, rack-mountable unit to a large dehydrator capable of pressurizing several large horn antennas.

► *Heat regenerative dehydrators* generally are used on low-pressure systems requiring as much as 0.5psi pressure.

These units can range in size from a small, rack-mountable unit to a large dehydrator capable of pressurizing several large horn antennas.

A heat regenerative unit operates by using two absorbing desiccant containers. Air passes through one of these containers, in which the moisture is absorbed to a specific value. Then the incoming air is switched to the second container.

The moisture in the first container is driven out by heat either applied within the container as resistive heat or exter-

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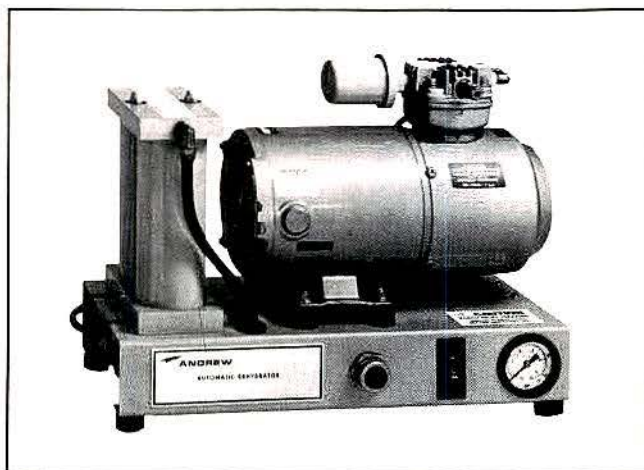


Photo 5. Pressure swing dehydrators have many advantages, including automatic regeneration, a 10-year to 15-year life expectancy and economical operation.

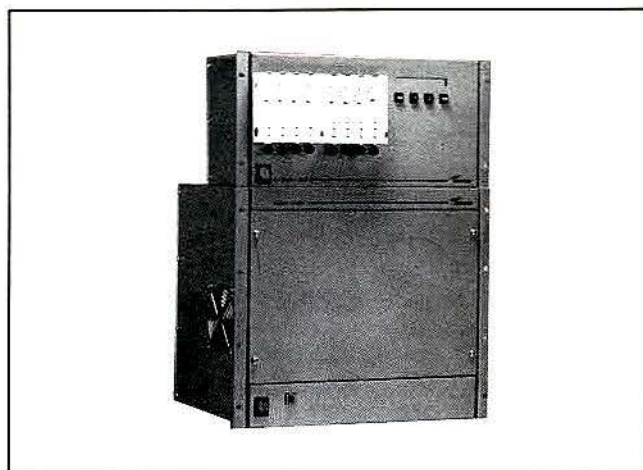


Photo 6. Membrane dryers are new to the industry. They offer exceptional reliability and dewpoints in excess of -50°F .

nal to the container in the form of heated air. The process reverses as required.

The smaller heat regenerative units' advantages are that they can be rack-mounted; their small, low-pressure compressors generate less noise and vibration; and they regenerate desiccant automatically.

Their disadvantages include the requirement of a larger amount of desiccant because of a longer regeneration time than their pressure swing counterparts and a greater number of components for plumbing and electrical circuitry.

When selecting a heat regenerative unit, make sure that the dehydrator is capable of continuous operation to protect the transmission line system integrity if a leak occurs.

► *Pressure swing* dehydrators incorporate the principle of moisture separation and desiccant absorption.

ration and desiccant absorption.

The units consist of a high-pressure compressor and two cylindrical absorption drying chambers that are switched by a timer control and solenoid-operated valve. The drying chambers are used alternately every 30 seconds. (See Photo 5 above.)

A molecular sieve desiccant normally is used. A molecule of water clings to the desiccant's zeolite crystalline structure. When the tower alternates, the solenoid valve at the base of the tower opens, allowing 65psi dry air from the drying side to blow the water molecules from the crystalline structure into the atmosphere from the wet side.

Approximately two-thirds of the compressed dry air is used to regenerate the tower, and the remaining one-third is sent to the system.

The advantages of the pressure swing

units include automatic regeneration, a 10-year to 15-year life expectancy, economical operation, dewpoints in excess of -40°F , high purge volume, high system volume and simple installation. For small systems, a bypass kit can be provided to eliminate short-cycling.

The disadvantages of these units are that they need ac power, they have moving parts and they tend to be noisy. These dehydrators are the largest and heaviest of those discussed.

Sometimes, too large of a dehydrator is installed on a system. This creates short-cycling of the towers and leads to tower saturation and high humidity alarms.

► *Membrane dryers* are new to the industry. They offer exceptional reliability and dewpoints in excess of -50°F . (See Photo 6 above.)

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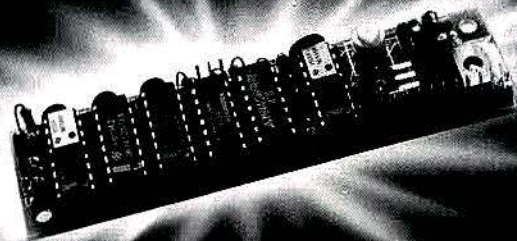
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The ULTRA-COM PRO comprises one main electronics package (MEP) and individual workstations. The MEP is housed in a standard equipment rack or equipment cabinet, and can be remoted up to 2500 feet from the workstations.

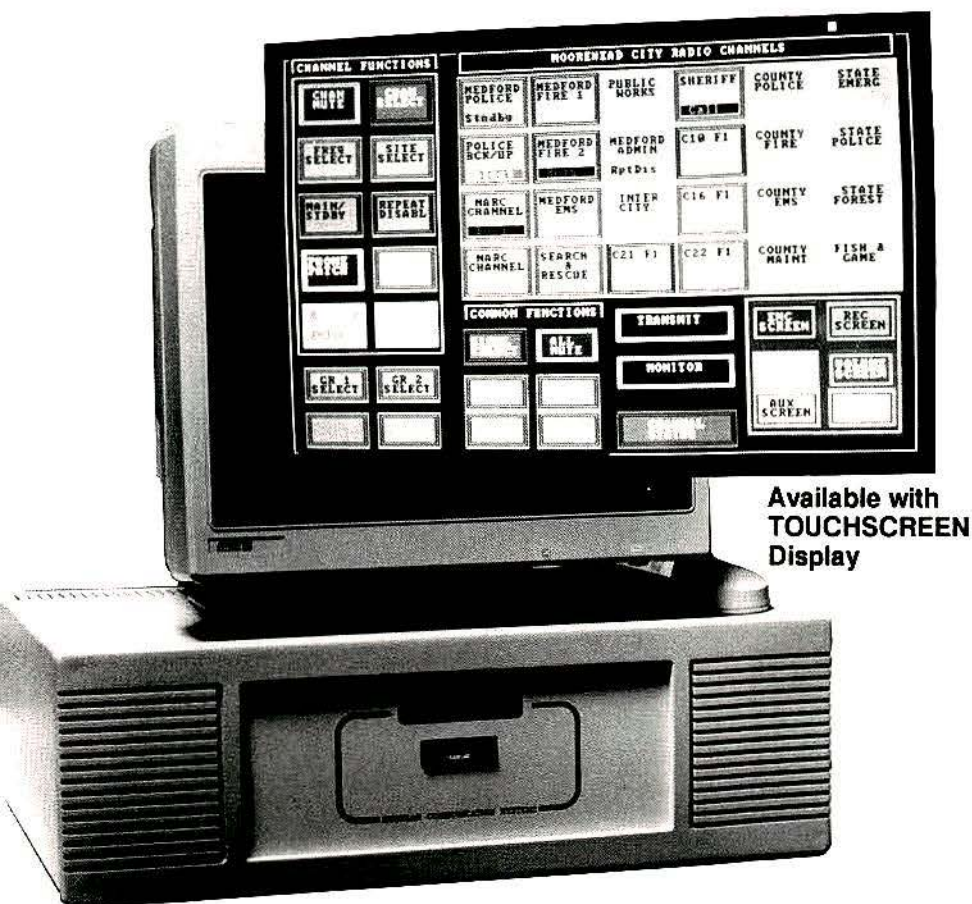
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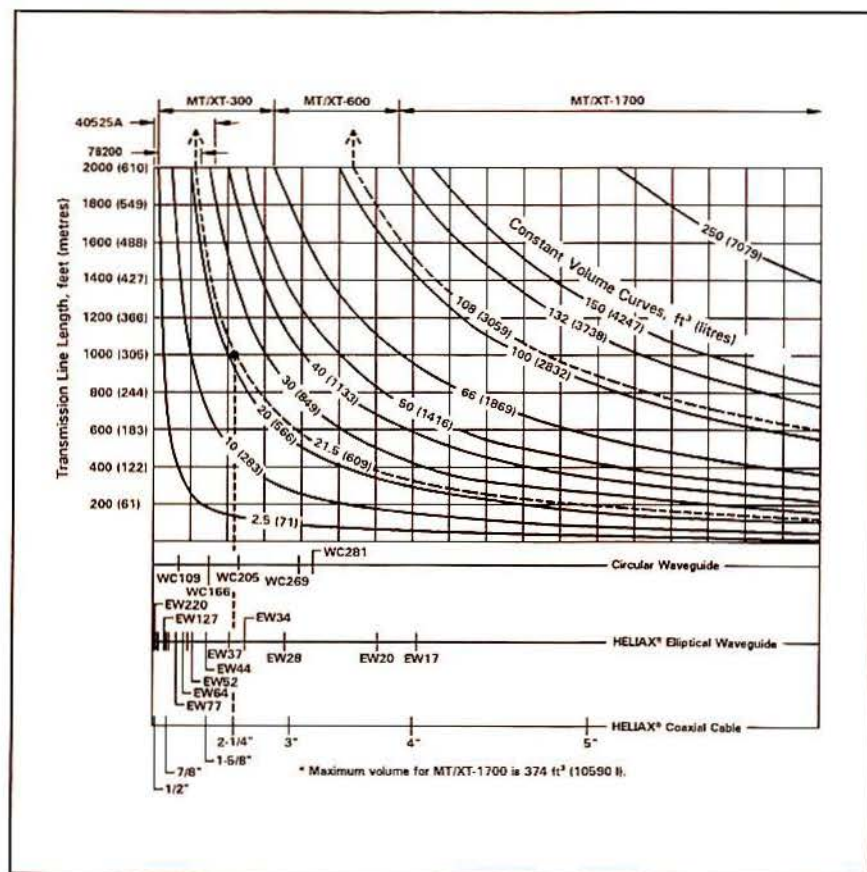


Figure 4. Transmission line vs. volume, and the recommended dehydrator to satisfy the demand.

system dewpoints in excess of -65°F . A membrane dryer that produces such a low dewpoint approaches the perform-

ance achieved by nitrogen without the cost and maintenance of bottles.

Moisture is separated by the permea-

tion process through an inert, maintenance-free fiber material instead of pressure swing molecular towers.

An advantage of using membrane dryers includes the doubling of MTBF calculations over the pressure swing and heat regenerative units because they have fewer parts. Membrane dryers have a higher capacity per compressor size with proportionately lower power consumption and quieter operation. Membrane dryers may be fitted with optional equipment to reduce noise output as low as 55dBA.

Among the disadvantages of membrane dryers are the need for ac power, the use of moving parts and the noise the compressor makes.

Proper sizing

Sizing the dehydrator properly affects its reliability and ability to provide dry air.

A dehydrator that is sized too small operates at a high duty cycle and requires compressor overhaul sooner. For manually regenerative units, a desiccant change is needed more frequently, increasing maintenance costs.

A pressure swing system dehydrator that is sized too large short-cycles and saturates the towers. Manual and heat regenerative units are unaffected when connected to a smaller system.

Properly sized, a dehydrator operates on a duty cycle of 5% to 10%. This duty cycle provides maintenance-free operation for the average system for as long as 10 years without a compressor overhaul.

Figure 4 above shows the relationship among transmission line size, volume and the recommended dehydrator to satisfy the demand properly.

To use the chart, select the transmission line size across the bottom of the chart. Proceed vertically until the length is intersected in the left-hand column. Then follow the volume curve to the top of the chart where the proper dehydrator series is shown.

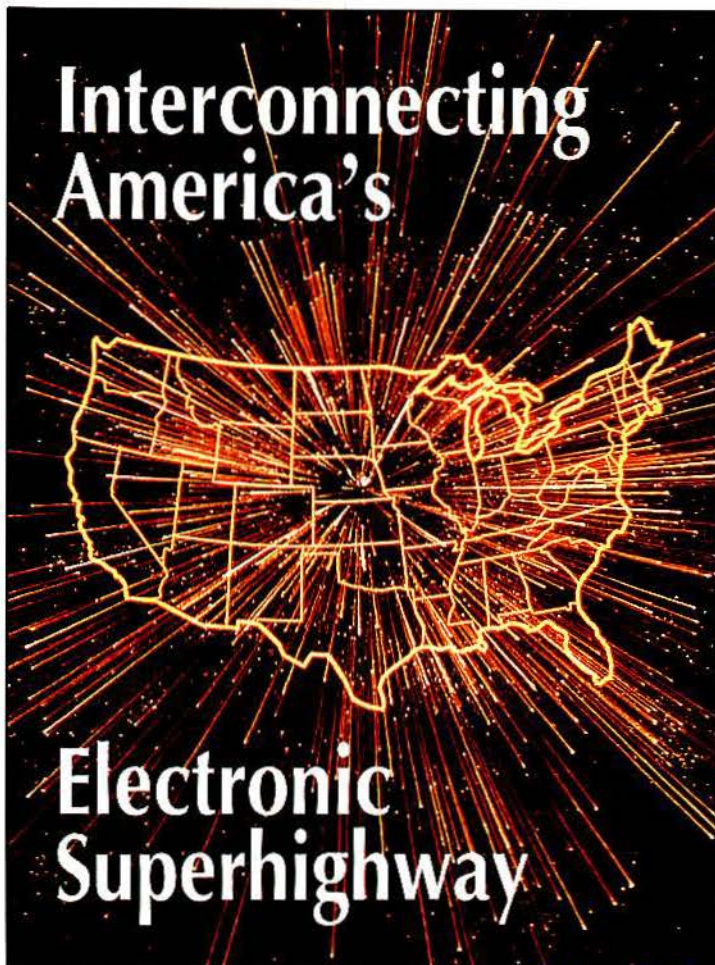
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September 22, 1992
at Telocator's Annual Convention,
Mobile Communications Marketplace

**Sponsored by Mobile Radio Technology
and Telocator, The Personal Communications
Industry Association**

The world may be evolving into the global village, but we are still traveling a bumpy road into the information age. Today's existing web of cellular, mobile radio, paging and telephone networks does not constitute the kind of powerful information infrastructure that we envision—no more than the thousands of US dirt roads in the early 1900s made a national highway system.

The fact is there will be no electronic superhighway in America until our wireless and landline networks are interconnected, guaranteeing the affordable delivery of voice, data, text and video to every person, home and business.

Join us for this one-time executive forum on what is being done to speed new interconnect arrangements that will benefit customers of both the landline and wireless networks, the economic impact of new network capabilities, how they will boost service revenues, new plans afoot to resolve "number scarcity" and whether regulatory changes are keeping pace with today's new interconnection push.

Call 800/326-8638 or send a fax to 202/467-6987 to register. Seating will be limited at this one-time only executive forum. \$125 for Telocator members with convention registration, \$250 for non-members with convention registration.

**Tuesday, September 22
San Francisco
The Moscone Center**

8:30 AM

**Interconnecting
America's Electronic Superhighway**

Chairman:

Don Bishop, Editorial Director

Mobile Radio Technology
and Cellular & Mobile International magazines
Intertec Publishing Corp.

9:00 AM

**Where the Network is Going—
and What It Means for the Wireless Industry**

Moderator:

Tom Mateer

Manager of Strategic Development, Sprint

Don Gayton, Engineer, Glenayre Electronics

**Gary Jones, Director of Business Development,
PCN America**

**Clyde Smith, Director of Technology
Development & Service Applications,
Bell Atlantic Mobile**

**Harry Young, Director of Wireless Interconnection,
Bellcore**

10:30 AM

Coffee Break

10:45 AM

**Looking Ahead: The Economic Impact
of New Network Capabilities**

Moderator: Andrew Roscoe, President, EMCI

Joe Kellagher, Consultant, Arthur D. Little, Inc.

**John Reddy, Chairman of College of Business,
Penn State University**

E.Y. Snowden, Area Vice President, Pacific Bell

12:15 PM

Keynote Luncheon

2:00 PM

The Numbering Maze

Moderator: Kurt Maass

Vice President, McCaw Cellular

**Jim Dombrowski, Vice President of Technical
Operations, Skytel**

**Fred Gaechter, Member of Technical
Staff-NANP, Bellcore**

**Marsha Ochs, Director of External Affairs,
McCaw Cellular**

3:30 PM

Coffee Break

3:45 PM

The Regulatory Agenda

Moderator: Kevin Kelley

Vice President, Qualcomm

Debra Lagapa, Attorney, Morrison & Foerster

Ray Kimball, Attorney, Ross & Hardies

Mitchell Wilk, President, Wilk & Associates

Systems integrators thrive in public safety market

The systems integrator trend appears to be gaining momentum in public safety and is recognized by the Associated Public-Safety Communications Officers (APCO), South Daytona, FL. APCO, a trade organization dedicated to the enhancement of public safety communications, plans a membership classification for systems integrators.

Under the Project 32 heading, APCO plans to generate information technology membership criteria for information technologists who support public safety communications. The association acknowledges a need for an information technology sector based on the influx of exhibitors involved in this area at its annual meeting and show, Aug. 9-14 in Seattle. System integrators such as Fairfax, VA-based TRW Command Support Division and International Business Machines' (IBM) Public Safety Solutions group exhibited at the show.

IBM launched a Public Safety Solutions group to specialize law enforcement automation, fire and emergency medical services. The IBM systems integration group joins the echelon of companies establishing such groups.

Using IBM as a systems integrator for public safety operations does not mandate the installation of IBM computers, software and product, according to Martin Tunon, senior partner for Public Safety Solutions, Little Rock, AR. Tunon said IBM acknowledges an operation's present system, characteristics and budgetary constraints in selecting a systems solution, and this may not involve IBM equipment.

The systems solution could require any or all of these items:

- prime contractor.
- project management.
- education and training.

- turnkey implementation.
- hardware and software installation.
- non-IBM product and software coordination, procurement and installation.
- maintenance and software services.

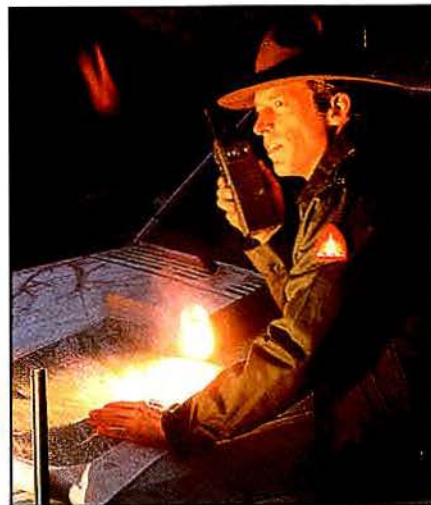
Public safety application solutions the IBM systems integration group addresses include interfaces with E 9-1-1; computer-aided dispatch; interfaces with state and National Crime Information Center systems; incident reporting and automated records management systems; system status planning; automatic vehicle location; mobile data terminals; hazardous materials; digitized mugshots; inventory and personnel systems; and fleet maintenance.

Ericsson GE Mobile Communications, Lynchburg, VA, is joining the IBM bandwagon with technology that will link its mobile radios with IBM mainframe and mid-range computers.

The combination of Ericsson GE's integrated wide-area voice-and-data trunking technology with IBM's application development will permit the transparent flow of data between a mobile data terminal such as the IBM PC Radio and host applications

such as IBM's Mobile Application Enabler.

The Ericsson-IBM combination will allow Ericsson's EDACS advanced radio system users to transmit mobile data enhancements. "This new linking of our systems for the purpose of providing mobile data enhancements will allow both companies to focus on their



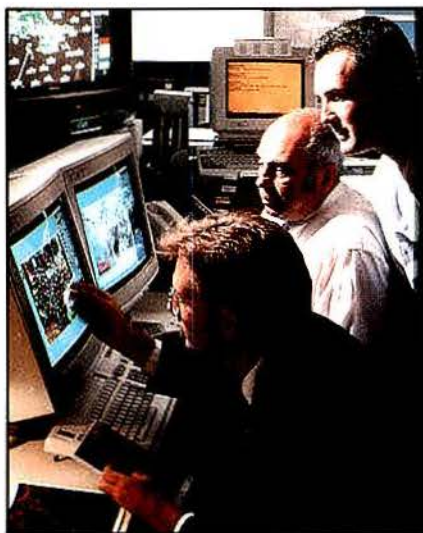
Systems integrators tie all realms of communications together. Many are discovering the public safety marketplace.

respective strengths," according to Dr. George Faith, vice president and general manager of Ericsson GE's land mobile radio business.

Ericsson GE's affiliations do not stop with IBM. The radio manufacturer and Harris Electronic Systems Division, Melbourne, FL, have formed an alliance to market land mobile systems to municipal, state and federal governments. "Ericsson has a global presence, and we found this exciting," said Ed Osborn, Harris director of radio and telecom business development.

As a systems integrator, Harris will incorporate Ericsson GE's land mobile radio products and systems into mobile voice and data systems for public safety and other groups. "Harris and Ericsson GE will provide the productive and flexible land mobile telecommunications systems on which municipalities, state and federal organizations depend," according to Lewis M. Kling, Electronic Systems Division vice president-general manager.

Harris is not tied to one technology, which it draws upon in its role as a systems integrator. As the federal government is de-classifying data, some of the items Harris manufactured exclusively for the federal market can be opened up to other arenas, according to Julia E. "Tibby" Parker, Electronic Systems Division marketing communications manager. About 70% of Har-



As a systems integrator, Harris brings centralized control to multifaceted mobile systems.

ris business used to be in federal contracts, and now that figure is about 40%, Parker said. This opens up a vast array of possibilities.

The potential exists for advances in finger print technology, such as putting finger prints over RF, she said. Videoconferencing over RF might be possible, as well.

APCO elects officers; Rand takes director post

The Associated Public-Safety Officers charges ahead to the 1992-93 year with the installation of new officers and the selection of an executive director.

Ronnie Rand, outgoing 1991-92 president, was confirmed as APCO's new executive director during its annual conference and meeting in August in Seattle. The South Daytona, FL-based group began its recruiting effort after longtime executive director Robert E. Tall retired in March during Rand's presidency.

Rand decided to pursue the executive director position and removed himself from the selection process committee. President-elect John Powell chaired the board of officers and conducted the business related to the recruitment and selection of the executive director.

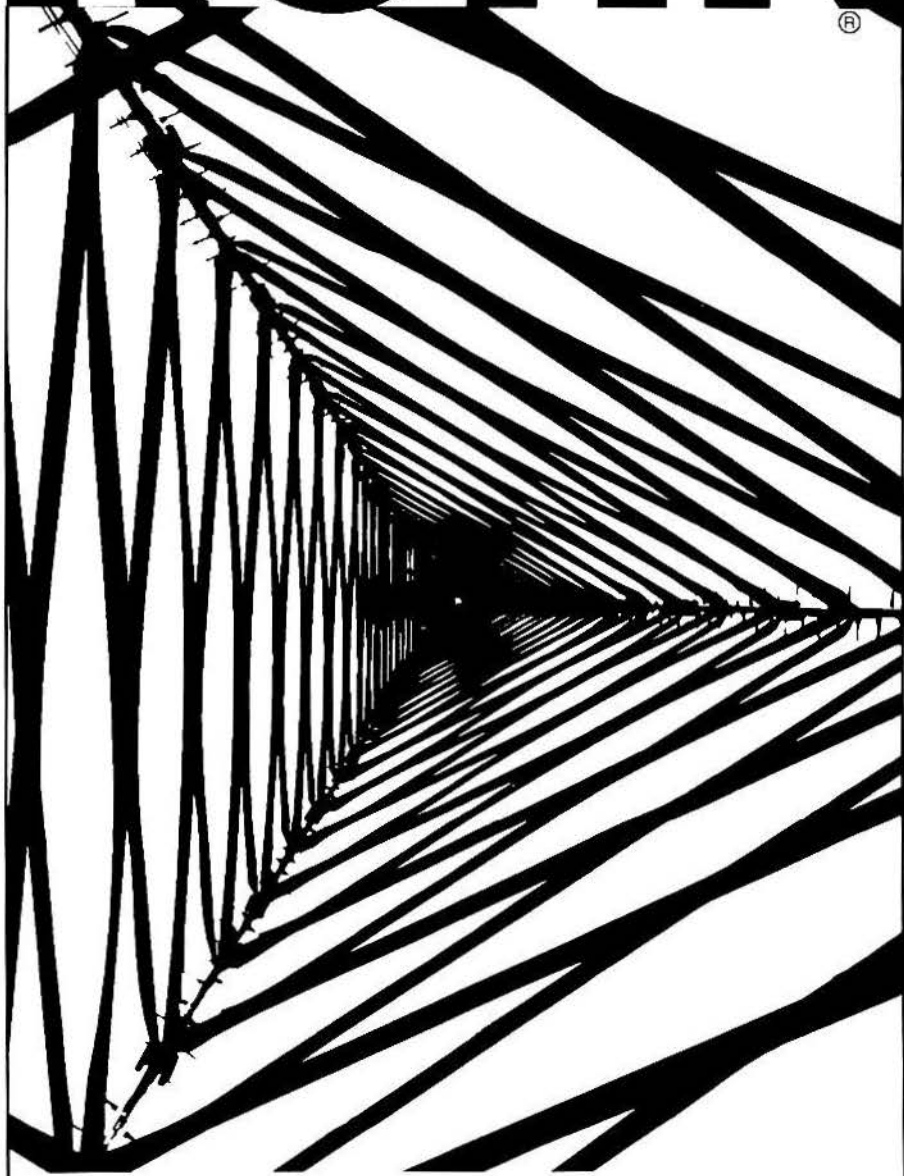
Candidates were reviewed based on the same criteria, including management of organizations with similar size and complexity; legislative and regulatory experience; and a vision for APCO's future.

At the outcome of the review, Rand was the only candidate with public safety communications experience and was selected by the recruitment and screening committee for the spot. The executive council was polled via mail ballot to confirm Rand's appointment, and Rand was confirmed at the Seattle meeting.

APCO selected Powell as president for the next year. Other new officers include president-elect Frank L. Huggins; first vice president Steven H. Proctor; and second vice president Ross Morris.

The APCO board of officers is the policy-determining body for the association and its subsidiaries.

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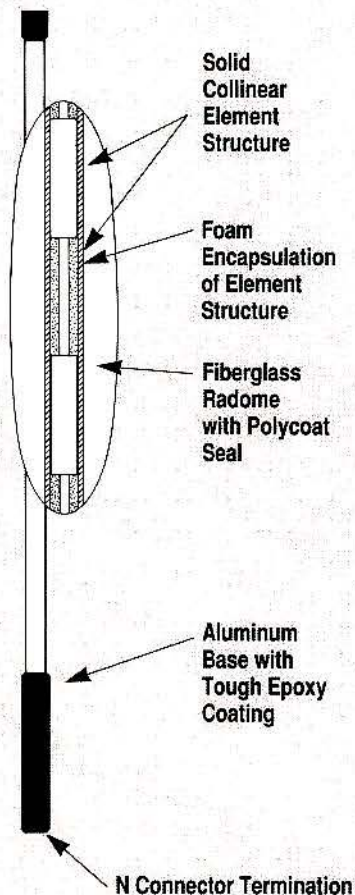
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News

NewsPager makes inroads in markets worldwide

NewsPager Corporation of America, (NCA) South San Francisco, CA, continues to gain business in domestic and international markets for its pager-based information system. The proprietary architecture is known as Pager Database Management/Operating System or PDM/OS software.

The company designed the first NewsPager prototype units in May 1987 and licensed its technology to Uniden in March 1988 to incorporate the PDM/OS software into its pagers. Uniden began production in April 1989, and NCA began international licensing activities based on Uniden's commitment. NCA licenses a major communications carrier in each country on an exclusive basis.

NCA licensed British Telecom for exclusive use of the NewsPager in the United Kingdom in April 1989; licensed Hutchison Paging in Hong Kong in April 1990; and licensed Deutsche Bundespost in June 1990 for operation in Germany.

In September 1991, Schaumburg,

IL-based Motorola was licensed to produce NewsPagers on its Advisor alphanumeric pager. NCA Information Services holds the exclusive license for North America and has been testing the technology for the past year. U.S. and Canadian commercial service is expected by the end of 1992.

Abroad, countrywide systems are in operation in Hong Kong, Germany and Australia. Expected countrywide systems in 1992 include Hutchison Telecommunications in Malaysia; Hutchison Paging in the United Kingdom; and Hutchison Telecommunications in Thailand.

Licenses in process in Europe include Spain, Norway, Sweden, Finland, France, Italy, Ireland, Belgium, Greece, Portugal, Switzerland, The Netherlands and Denmark.

In Asia, licenses are in process in Taiwan, People's Republic of China, Japan, Singapore, Philippines and Indonesia.

The NewsPager technology enables data to be received by a licensed pager.

Puerto Rico public safety agencies benefit from multisite trunked system

Mass congestion on Puerto Rico's conventional radio systems; public safety agencies sharing frequencies with commercial business users; and a lack of coverage in many areas led the Puerto Rico Communications Corporation (PRCC) to seek out a radio communications system for islandwide coverage. PRCC manages and maintains all public safety radio communications systems for the island.

After investigating radio communications possibilities, PRCC released a public safety trunking system bid request. The agency, with the assistance of CodeCom, a local E. F. Johnson distributor, selected Johnson's Multi-Net trunked system.

The system installation includes nine repeater sites and 24 active RF channels located throughout the island. Sites are networked to a single radio network terminal that can handle 30 RF channels.

The trunked system currently is used

by 13 public safety agencies on the island. Each agency has its own talk groups, and inter-agency talk groups can be used when the need for interoperability among public safety agencies arises in crisis situations.

The Puerto Rico Fire Department is the primary user group on the system with two consoles and about 700 radios. The system enables a firefighter to access the available channel with the PTT button in less than 500ms.

Puerto Rico agencies using the trunking system include Puerto Rico Fire Brigade; Highway Authority; Emergency Medical Service Administration; Consumer Affairs Department; Housing Development Agency; Aqueduct and Sewer Authority; Department of Education; and Civil Defense.

Other agencies on the trunked network are Government Insurance Agency; Puerto Rico Telephone Corporation; and the Federal Emergency Management Administration.



ACT reaches out to technicians in new areas

By Thomas Green

During the May 7 ACT volunteer leadership council meeting, council members emphasized the importance of reaching out to technicians in related industries, such as railroads and utilities.

These are fields that traditionally have not been well represented in ACT and the NABER technician certification program. ACT members receive:

- current technical information.
- the opportunity to increase technical skills.
- the opportunity to advance

professionally and improve their compensation.

➤ recognition as a top-quality service professional.

Technicians from related industries have expressed a high degree of satisfaction with the benefits they receive from ACT.


Through *Business Radio* magazine, they gain access to information on state-of-the-art technology and practical troubleshooting techniques.

Decisions made by the FCC and Congress can affect technicians. Thus, many technicians represented by ACT have found the group's regulatory information valuable.

An increasing number of companies in related industries only hire certified technicians because certification indicates a service professional's competence. ACT members and NABER-certified technicians are recognized widely as proven professionals.

The association continues to seek an expanding pool of technicians and to represent all areas of the mobile communications industry to broaden its perspective and offer better service.

'Military recruiting'

Last year, the council proposed that the association seek members in the military. This effort has succeeded as former service men and women re-enter the civilian workforce. 

Green is instructor and communications manager of communications electronics at Ranken Technical College, St. Louis. He is ACT's volunteer leadership council chairman. ACT, the Association of Communications Technicians, is a membership section of NABER, the National Association of Business and Educational Radio.

Information

Technician certification exams are offered Monday through Friday at Plato centers throughout the country.

For more information about ACT and technician certification information and exam appointments, call 800-759-0300. Ask for 'technician services.'

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Paging group wants approval to serve individuals

The Association for Private Carrier Paging (APCP), Alexandria, VA, has asked the FCC to allow private carrier paging (PCP) system licensees to offer paging service to individuals. PCP licensees are prohibited from providing paging service to individuals.

In many markets, PCP licensees use retail outlets to distribute pagers. Many retailers are hesitant to sell service on PCP systems because of the extensive eligibility requirements. Those retailers opt to work with common carriers that can serve individuals.

Fleet Call requests auction for unused SMR channels

Fleet Call, Bloomfield, NJ, the nation's second largest operator of specialized mobile radio (SMR) systems, has asked the FCC to auction 800MHz SMR spectrum in certain markets.

The company wants a nationwide SMR system created, and the licensing spectrum in blocks large enough to

support high-capacity digital systems is a possible element in such a plan.

Large blocks of spectrum are unused in many of the smaller markets because of insufficient customer demand. Selling the spectrum to licensees prepared to carry out plans for nationwide service may put that spectrum to use.

Supplier council asks FCC for new VHF band function

The Council of Independent Communications Suppliers, an Arlington, VA-based radio communications trade association, has asked the FCC to permit increased use of frequencies in the 156MHz-to-162MHz band by the Industrial and Land Transportation Pri-

ivate Land Mobile Radio Services.

The council proposes 12.5kHz offset channels, specific geographic separations among stations and power limitations, as well as new channels coordinated by the Special Industrial Radio Service Association, Arlington.

Trade group asks commission to license wide-area private land mobile radio systems

The National Association of Business and Educational Radio (NABER) has petitioned the FCC provide for the licensing of wide-area private land mobile radio systems to Business Radio Service (BRS) eligible entities

and specialized mobile radio (SMR) systems.

According to current FCC rules, a NABER document reads, wide-area systems are permitted for all categories of eligibles except SMR systems.

UTC, citing President Bush, asks FCC for 2GHz licenses

The Utilities Telecommunications Council, citing President Bush's call for a moratorium on new government regulations to stimulate the economy, has asked the FCC to postpone its decision not to grant any more fixed microwave licenses on a primary basis in the 2GHz radio band.

The agency has released its proposal to reallocate the 2GHz band to emerging telecommunications technologies. Under the proposal, all applications for new 2GHz facilities received after Jan. 16, 1992, are to be granted on a secondary basis.

Alcatel proposes relocation for 2GHz spectrum users

Alcatel Network Systems, Richardson, TX, has asked the FCC to adopt technical and operational rules for microwave users in bands above 3GHz. The proposed rules would accommodate the migration of present microwave systems occupying the 2GHz band. The 2GHz band has been targeted for use by prospective operators of personal communications services systems.

Additionally, remote stations in wide-area systems licensed to BRS users are authorized only on a secondary basis. Regional SMR systems using the same frequency are not permitted without a waiver.



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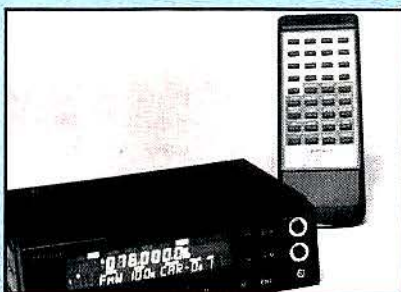
Readers' choice

Of all the new products and services in the March issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Wideband receiver scans up to 35 channels per second

The SR001 wideband receiver from **Shinwa Communications of America** covers 25MHz to 999.999MHz with continuous scanning. Features include scan of 35 channels per second; programmable indicators; LCD; front-panel or remote control selection of frequency and mode; and 200-channel memory.

Circle (513) on Fast Fact Card



Bicycle helmet package includes mic, PTT switch

The bicycle helmet Comkit from **Setcom** includes a three-part system with a mic, built-in speaker and cable assembly that interfaces to a portable

radio. The system includes a handle-bar PTT switch. The package easily mounts on a variety of bicycle helmets.

Circle (515) on Fast Fact Card

Battery conditioning system targets consumers

The MC-01 Discovery battery conditioning system is aimed at consumers for recharging NiCd batteries used in Motorola 8000, 950 and Ultra-classic cellular phones, as well as other compatible cellular telephones. Made by **Surecharge Industries**, the conditioning and recharging system increases the life of NiCd batteries by a minimum of five times more than that expected by conventional charging methods. The system maintains 100% of the rated energy every time a battery is conditioned.

Circle (514) on Fast Fact Card



Voice storage, relay option improves portable range



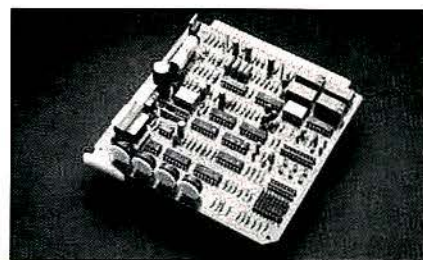
A built-in dual-mode voice storage and message relay option is available for **Midland LMR's** Syn-Tech two-way radios. The voice storage mode enables a user to record a status message before leaving the vehicle. The relay mode boosts the talk-back range of a portable-equipped user when away from the vehicle.

Circle (226) on Fast Fact Card

Termination panel provides two channel selections

Model 824AA dc termination panel provides PTT, monitor and as many as two channel selections. The **Solid-State Communications** panel mounts in any 56-pin telephone standard enclosure. The panel can detect three positive and three negative current levels for a given control format.

Circle (282) on Fast Fact Card

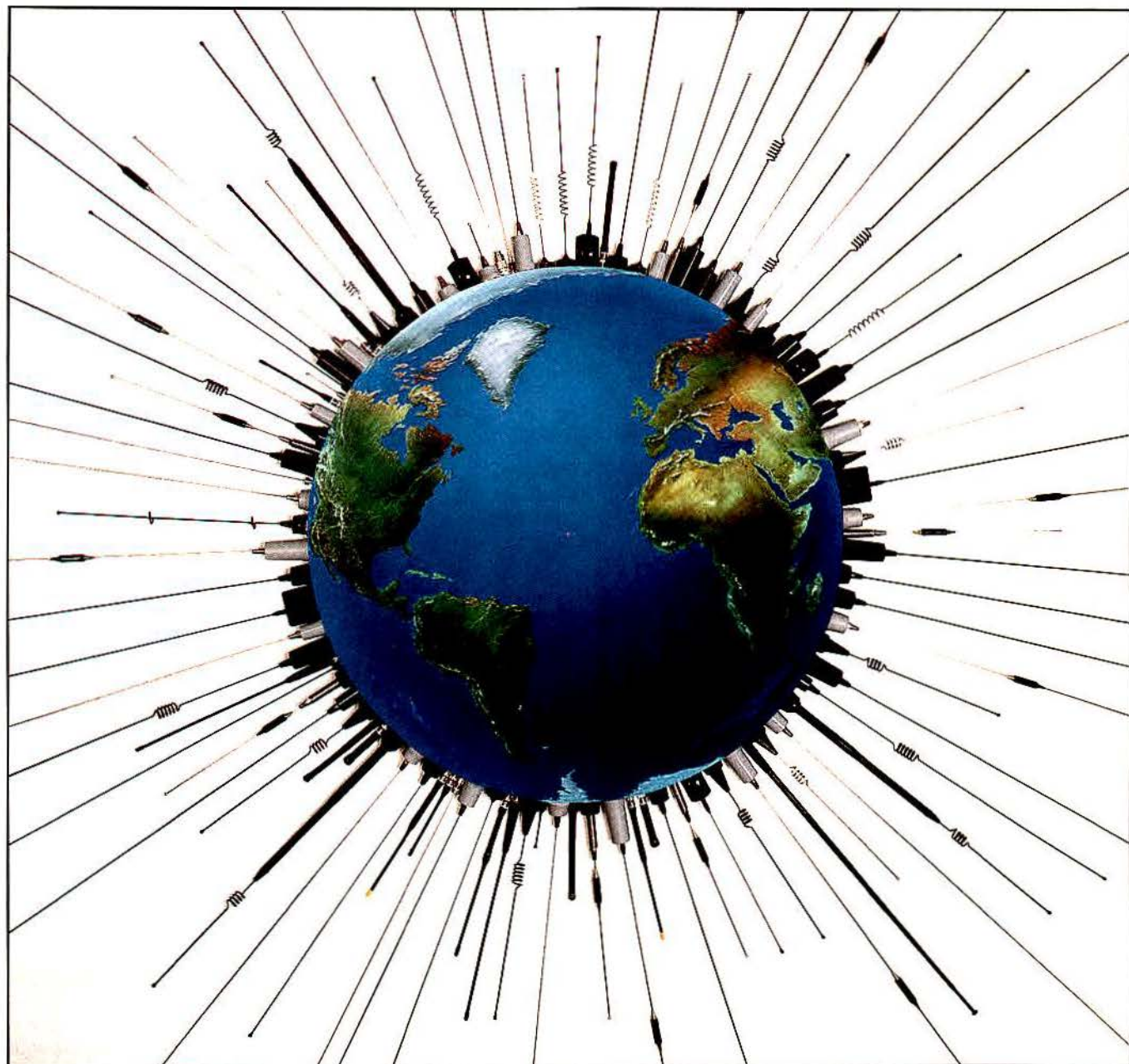


Cable fault locator reads to 65,000 feet



Model 1220 time domain reflectometer from **Riser Bond** boasts long-range readings to 65,000 feet. The cable fault locator suits troubleshooting tower, aerial and underground cables, as well as cables in conduits and behind finished walls. The unit weighs less than 10 pounds and offers high-precision accuracy in its readings.

Circle (285) on Fast Fact Card



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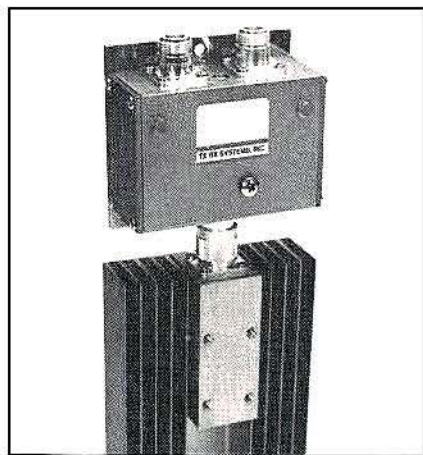


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New products

Ferrite isolators span 118MHz-to-300MHz range



Single- and dual-junction circulators and isolators from **Tx Rx Systems** cover the 118MHz-to-300MHz range. Models are available for the subranges of 118MHz to 136MHz, 132MHz to 150MHz, 144MHz to 174MHz and 220MHz to 250MHz.

Circle (290) on Fast Fact Card

Tower light monitor system sends data to pagers, PCs

The ProTekTor control system from **PageTek** features two analog inputs, four digital inputs and four relay driver outputs for monitor and control of tower lights, as well as other communications equipment. The unit provides alert calls to pagers, people and computers.

Circle (300) on Fast Fact Card

Software analyzes RF site interference

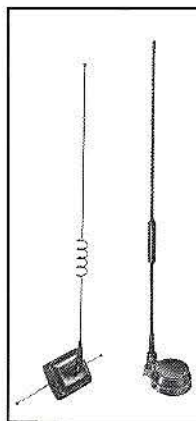
The ComSitePlus integrated software from **Douglas Integrated Software** combines the DesensePlus and IntermodPlus programs into a communications site RF interference analysis package. The software determines isolation values required to prevent no more than 1dB degradation of a receiver's 12dB SINAD sensitivity due to transmitter noise and receiver desensitization.

Circle (297) on Fast Fact Card

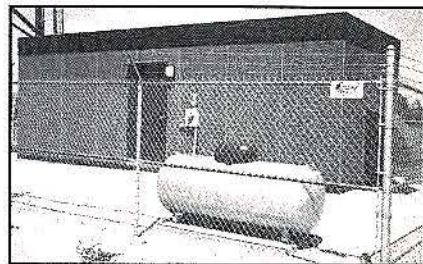
Glass-mount antennas include passive repeater unit

Two glass-mount cellular antennas are available from **Harada Industry of America**: the CAWB-32 with antiwind noise mast and the CAWB-63 with a passive repeater. The CAWB-32 installs easily and can be removed and remounted with a kit. The CAWB-63 is designed for use with cellular portables.

Circle (272) on Fast Fact Card



Transportable shelter comes in custom sizes with options



Communications equipment shelters from **Professional Systems** are transportable and can be made to any size. The L.E. Hut buildings are available with various exteriors and roof designs. Factory-installed equipment includes customer preferences in HVAC, alarm, standby power, electrical and other options.

Circle (271) on Fast Fact Card

Dispatch control software supports pager interface

Tracker Version II dispatch control software includes a pager interface that allows a dispatcher to send numeric and alphanumeric messages. The **Advantage Software** program requires a hard disk IBM-compatible computer with 512K memory and a modem for paging.

Circle (262) on Fast Fact Card

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Circle (68) on Fast Fact Card

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The CR300 series can record up to 20 individual channels of audio. With TEAC'S VHS format your recordings are protected inside a compact cassette. So, you don't have to worry about all the problems of handling and storing tape reels.

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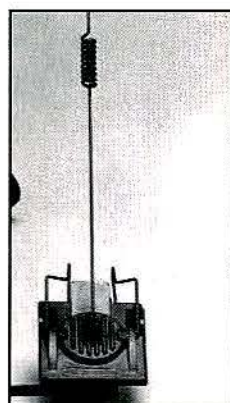
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Circle (80) on Fast Fact Card

New products

Clip-on antenna to improve vehicular hand-held reception

The clip-on coupler antenna from **Mobile Mark** works with the Motorola Micro T A C cellular hand-held for better in-vehicle performance. The antenna slides on and off a vehicle door's window, and the whip is outside the car for better reception.



Circle (266) on Fast Fact Card

Fume extractor fits most soldering irons

The Tip-EVAC fume extraction system from **Pace** fits most soldering irons and removes fumes created during hand soldering. The fumes are extracted right at the soldering iron tip. Tubes for the unit are available in a variety of clip-on and screw-on versions.



Circle (298) on Fast Fact Card

GPS-AVL products suit large, small fleets

GPS-AVL products from **Coded Communications** include the Lanmarc-5000 for large fleets and the Lanmarc Easy-Link for smaller fleets. The products are compatible with any radio system and are plug-compatible. The Lanmarc-5000 manages and tracks a large fleet in real time and can be used in both conventional and trunking systems. It offers CAD integration. Easy-Link makes using AVL feasible for fleets with as few as 10 vehicles. The unit can operate alone or can be integrated into a CAD system.

Circle (299) on Fast Fact Card



0.02⁵⁰

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Dictaphone

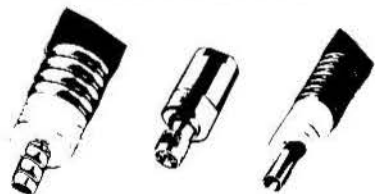
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Circle (82) on Fast Fact Card

Literature

Handbook explains cellular industry

The second edition of the *Cellular Radio Handbook* from **Quantum Publishing** contains 765 pages and includes 42 chapters and more than 300 illustrations explaining the intricacies of designing, installing and operating

a cellular network. The book explains both the theory and practice of cellular systems, but it is structured so non-technical readers can bypass mathematically oriented sections without losing overall comprehension.

Circle (413) on Fast Fact Card

Handbook gives overview of SMR industry

A 125-page handbook describing the SMR industry from **BIA Publications** gives a detailed history of the industry. The handbook includes regulatory and

technical overviews; operational and economic considerations; and market, technological and regulatory trends.

Circle (414) on Fast Fact Card

Catalog describes grounding devices

The 1992-1993 catalog from **PolyPhaser** shows its line of lightning arrestors and grounding devices. This newly formatted edition includes new products and a revised lightning protection information appendix.

Circle (417) on Fast Fact Card

Application note outlines cable tips

A two-page application note from **M/A-Com** outlines 16 tips for handling and using coaxial cable assemblies without degrading their performance.

Circle (418) on Fast Fact Card



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Circle (83) on Fast Fact Card

PCN receives favorable marks

Personal communications networks (PCNs) promise to change the way the traditional land mobile industry communicates, and 76.2% of the respondents to the March 1992 "What Do You Think?" questionnaire believe these systems will be viable. Reasons readers are optimistic about PCN include:

- "It will increase mobility and flexibility."
- "The technology and benefits it brings to a needy marketplace outweigh its costs."
- "The increasing need for constant communication makes it viable."
- "The growth of cellular shows the need for personal communications. It will expand in the metro areas."

Benefits readers recognize in PCN wireless in-building communications systems include not missing important calls; costs saved in wiring and cabling; time and expense saved in returning calls; technical communication improvements; and equipment with more features.

One of the main advantages of personal communications use is the ability to use one communications device to reach anyone, anytime and anywhere. Respondents believe using one device is advantageous because:

- "It allows mobility."
- "Simple for user and callers."

• "Efficient and minimum equipment is needed."

• "Device makes it easier to reach people instead of using telephone, answering machines and secretaries."

• "I won't have to maintain two or more types of end devices."

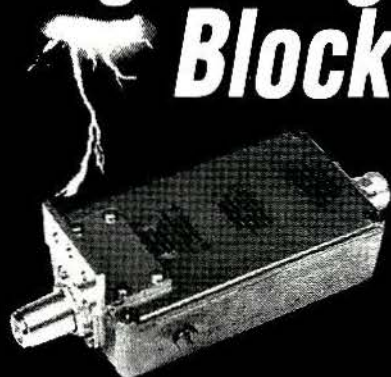
Technological development respondents would like to see incorporated in PCNs include:

- "Auto registration, auto call forwarding."
- "Common protocols, common modules in hardware."
- "Improved battery life."
- "More privacy protection, caller ID and class services."
- "Voice mail and easy roaming."
- "Remote data transfer."
- "Less vulnerability to transient from external sources."
- "Standardized equipment."
- "Roaming features."
- "Fax capabilities."

Be sure to fill out this month's "What Do You Think?" questionnaire on page 97 so your responses can be included in a future "Feedback" column.



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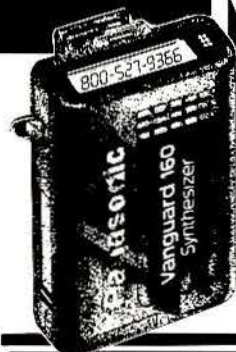
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Circle (70) on Fast Fact Card

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Circle (69) on Fast Fact Card

TNF-200 Tuneable Notch Filters 1.5-850 MHz



Features

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- Passes to 2.4 GHz
- Up to 25 watts power
- Rugged construction
- Cost : low as \$89.10

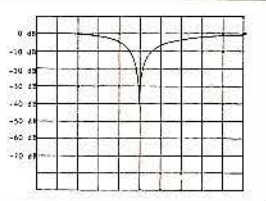
TNF-200 is a family of nine models notch filters, covering 1.5 to 850 MHz., with low insertion loss over an extremely wide bandwidth. For example the 30 MHz version passes >500 MHz or 13 times the notch frequency. This is superior to cavity filters, which also are much larger and more costly. Most of the models cover more than one octave using one easily tuned adjustment. High Q circuitry assures a deep notch and low insertion loss (less than 0.5 dB at 1.0 GHz) thus making EAGLE filters your best choice.

These filters are useful for high performance spectrum measurements by providing a 20 to 30 dB improvement of analyzer dynamic range. In harmonic measurements, for example, simply notch the carrier and remove some attenuation to view low level harmonics.

Notch filters can also be used to eliminate or identify off-band interference in communication systems.

The TNF-200 filters are in stock for immediate delivery!

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People



Jackman



Serensa



Kitchen

Rick Jackman departs Glenayre Electronics, Charlotte, NC, as director of sales to join Unipage, DeSoto, TX, as senior account executive with an office in Bristol, CT.

Bob Serensa leaves Mx-Com, Winston-Salem, NC, as dealer sales manager to join Midian Electronics, Tucson, AZ, as sales manager.

E.B. "Jay" Kitchen, president of the National Association of Business and Educational Radio (NABER), Alexandria, VA, was appointed by Secretary of Agriculture Edward Madigan and Secretary of the Interior Manuel Lujan to serve on the U.S. Forest Service's Radio and Television Broadcast Use Advisory Committee.

Promotions at Avtec, Gilbert, SC:

Uday Menon, C/UNIX programmer, moves up to manager of software development.

Michael T. Branning, design engineer, advances to electronics department manager.

Craig E. Davis, chief financial officer at Natcom, Jackson, MS, adds the assignment as chief operating officer to his responsibilities.

Sandra Covin departs Metagram America, New York, a division of Millicom, as vice president of operations to join the National Dispatch Center (NDC), San Diego, as vice president of dispatch operations.

Nat Machain leaves Motorola, based in Schaumburg, IL, as business unit manager to become assistant vice president for site acquisitions at AAT Communications, Lawrence, MA.

Changes at Fleet Call, Rutherford, NJ:

Joel Schleicher, executive vice president, advances to president of specialized mobile radio (SMR) operations.

Jim Dixon, vice president, moves up to president of digital mobile network operations.

Richard H. "Dick" Stewart adds the post of chairman of the American Mobile Telecommunications Association, Washington, DC, to his business responsibilities. Stewart is chief executive officer of Transit Communications Atlanta, a specialized mobile radio operator. In addition, he heads other paging, equipment sales and radio antenna site businesses.



October

8-10—**Special Industrial Radio Service Association Annual Meeting**, Grove Park Inn, Asheville, NC. Contact: Barbara J. Levermann, 703-528-5115.

24-29—**International Association of Chiefs of Police Annual Conference**, Detroit and Windsor, Ontario. Contact: 703-243-6500.

November

12-15—**Communications Marketing Conference**, John Ascauga's Nugget Hotel, Reno, NV. Contact: Gene Johnson, Vega Signaling, 818-442-0782.

20—**Radio Club of America Awards Banquet**, New York Athletic Club, New York. Contact: 201-652-6811.

1993

February

1-2—**AMTEX**, the American Mobile Telecommunications Association's Marketing and Technology Conference and Exposition, New Orleans. Contact: 202-331-7773.

March

3-5—**Cellular Telecommunications Industry Association Winter Meeting and Exposition**, Dallas Convention Center, Dallas. Contact: 202-785-0081.

17-19—**Western States Regional Conference Associated Public-Safety Communications Officers Meeting**, Hyatt Regency, Phoenix. Contact: Deborah L. Overton, 602-256-1029.

21-24—**Energy Telecommunications and Electrical Association**, New Orleans Convention Center, New Orleans. Contact: 214-235-0655.

23-25—**International Mobile Communications Expo/Spring**, Anaheim Convention Center, Anaheim, CA. Contact: 303-220-0600.

April

19-22—**Supercomm and Telocator Spring Conference**, Georgia World Congress Center, Atlanta. Contact: 800-326-8638.

21-23—**North Central Regional Conference Associated Public-Safety Communications Officers Meeting**, Radisson Inn Bismarck, Bismarck, ND. Contact: Lyle V. Gallagher, 701-224-2127.

May

12-14—**Annual Mobile Communications Conference**, sponsored by the National Association of Business and Educational Radio (NABER), Hyatt Regency Hotel, San Antonio. Contact: NABER, 800-759-0300.

17-20—**East Coast Regional Conference Associated Public-Safety Communications Officers Meeting**, location and chairman to be announced.

18-20—**Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Meadowlands Hilton, Secaucus, NJ. Contact: George D. Gaul, 908-290-1128; fax 908-290-1932.

26-28—**RadioComm**, Metro Toronto Convention Centre, Toronto. Contact: Lisa La Prairie, 613-233-4888.

June

29-July 1—**Utilities Telecommunications Council Annual Meeting**, San Antonio Marriott Rivercenter and Convention Center, San Antonio.



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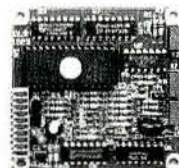
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± 600Khz @ 145 Mhz: 28db	
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± 5 Mhz @ 450 Mhz: 50db (60db GaAs)	± 20 Mhz @ 950 Mhz: 70db

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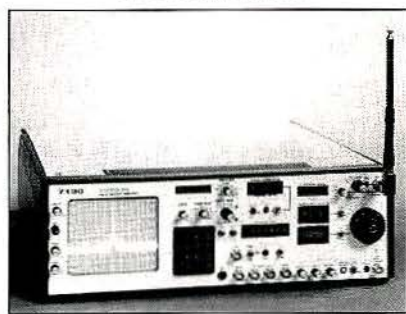
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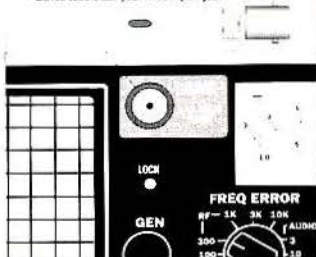
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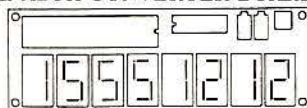
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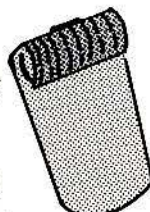
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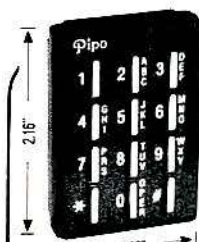
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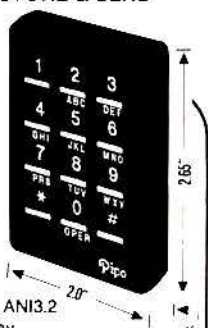
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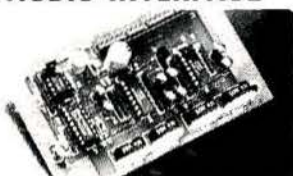
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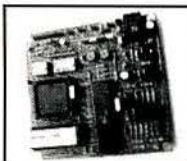
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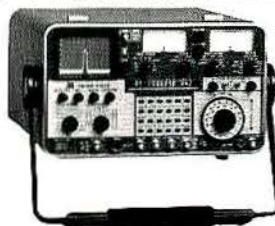
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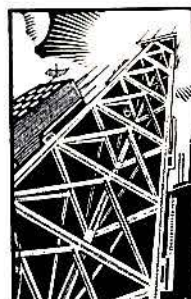
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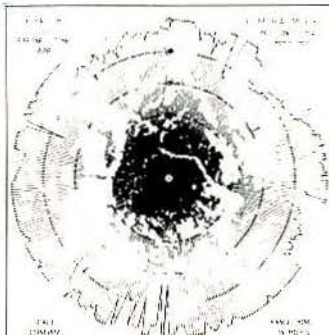
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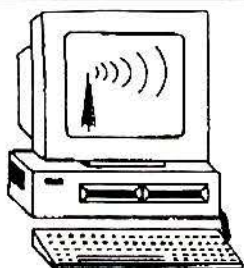
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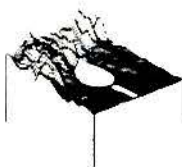


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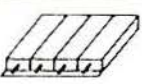
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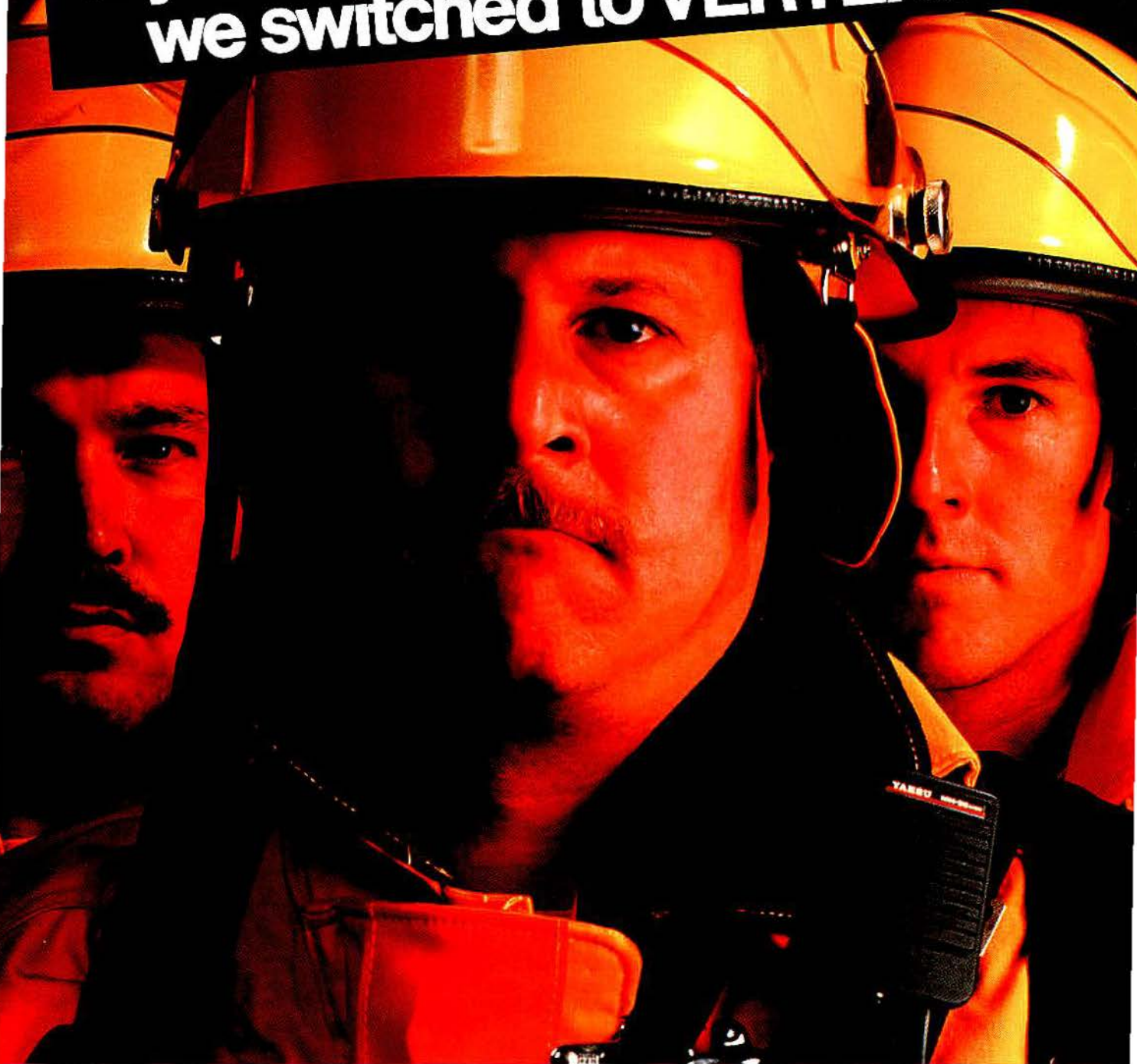
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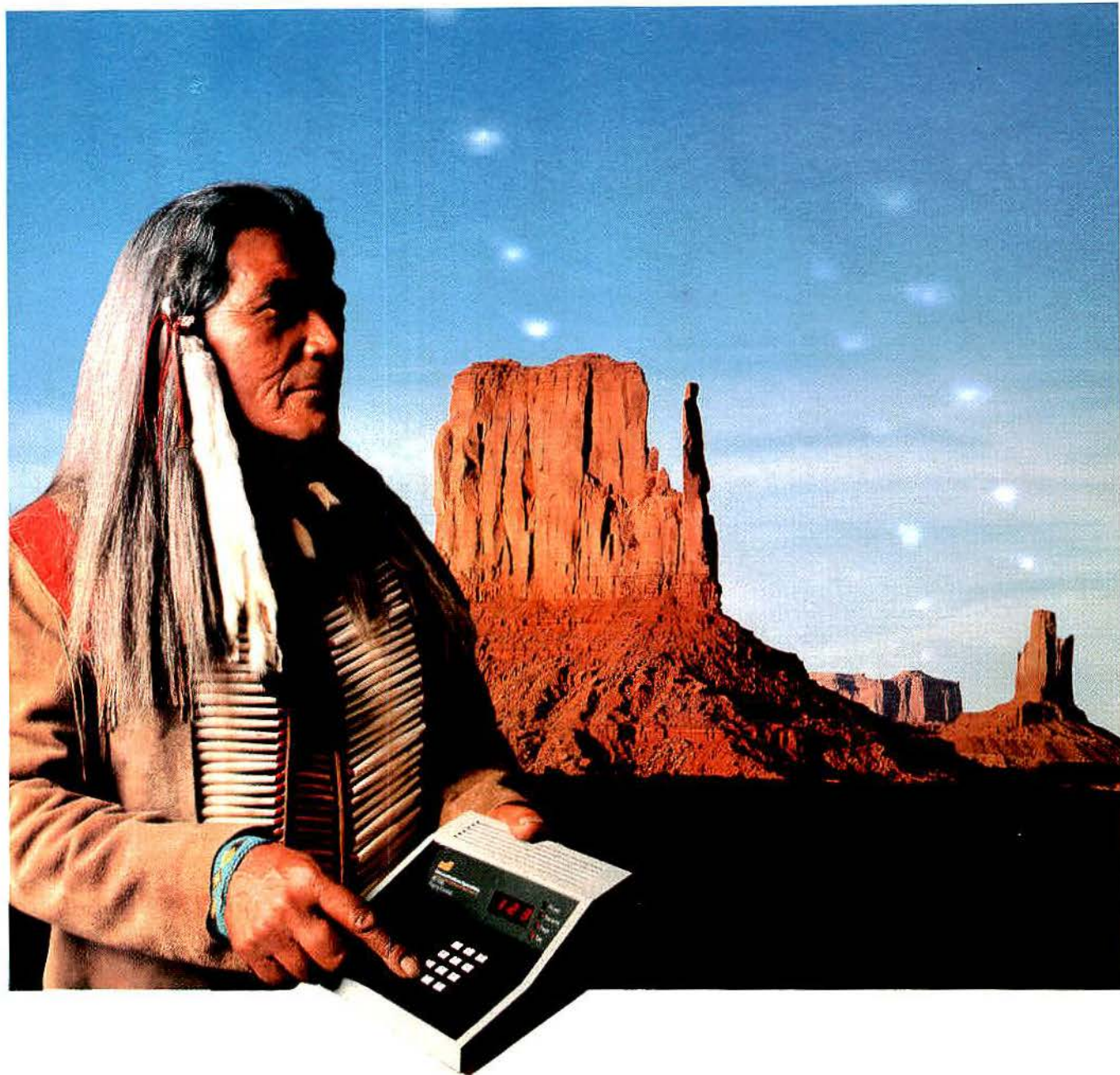
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